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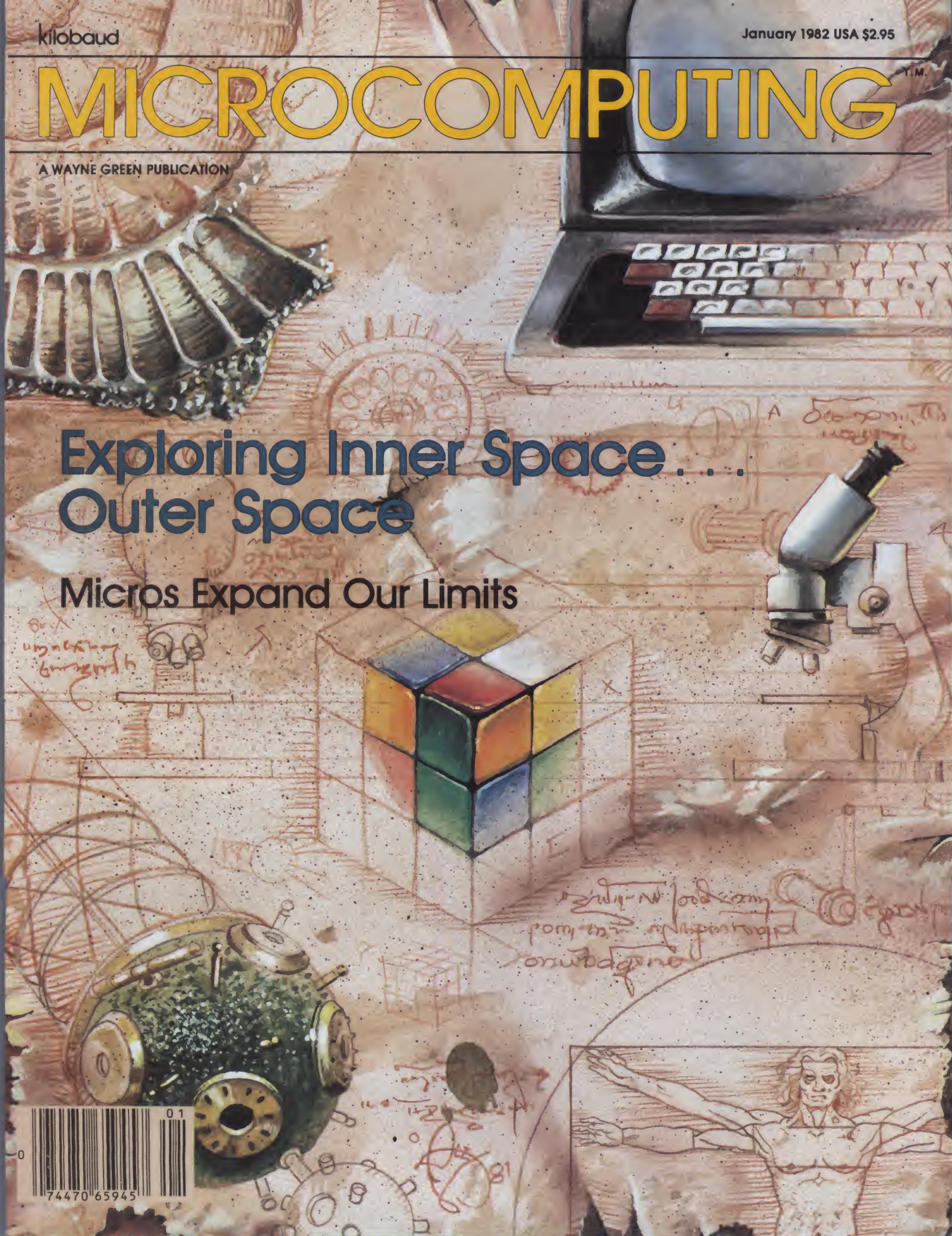
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APPLICATIONS

28 Rubik's Cube Demystified Curtis and Lillian Cooper

Apple

With practice, you can master this puzzle.

32 First Aid for Cuber's Thumb Paul Turvill

For Z-80 puzzle buffs to reduce the risk of thumb-joint injury.

DATA COMMUNICATIONS

118 Expand Your Horizon Patrick Corry

North Star

Reach out and touch another computer.

GENERAL INTEREST

145 Bag It Kenneth Reid

Now there's no need to cry over spilled milk.

145 Hex Table F. LaPointe

A handy reference for hex addition and subtraction.

HARDWARE MODIFICATIONS AND CONSTRUCTION PROJECTS

102 Computer/Video Disk Combo That Really Works! P. Anderson, E. Carr PET

PET and Pioneer give you computer-aided video disk instruction.

110 Upgrade Your IDS Printer Peter Noeth

TRS-80 and IP-225 get together with this simple interface.

152 Power Jump for the 1802 Brian McCorkle

Give your keyboard, and your fingers, a rest with this simple circuit.

REVIEWS

96 Changing Chips in Midstream Michael Wolf

A look at Radio Shack's full-featured, low-cost Color Computer.

112 Spotlight on the Starwriter Mark Borgerson

The first of two articles on C. Itoh's printer.

114 Letter-Quality Printer for the Budget-Minded William Colsher

It's a lotta printer for the money.



Page 32.

Page 80.



Contents: January 1982

Volume VI

No. 1

SCIENTIFIC APPLICATIONS

Apple	Fred J. Gunther	Uncovering the Earth's History	60
		A program to gather data and analyze geologic research.	
Apple	Paul Ward	Red Hot Computing	68
		Recording graphic data that's too hot to handle.	
Heath	Robert Bradley	Tapping into the Brain	72
		Neurophysiologists crack the "last frontier of biology."	
	Susannah West	Planetarium Shows with a Difference	80
		Ever wonder what puts the twinkle in those little stars?	
Apple	Gurba, Deininger, Berger	The Toxic Apple	86
		A perfect lab assistant to measure toxic health hazards.	

SOFTWARE

Sorcerer	C. Kevin McCabe	The Sorcerer Reveals Hidden Commands	128
		Use monitor commands in BASIC programs.	
PET	Charles Trahan	The Revealing Truth about PET's Memory	132
		A BASIC text disassembler that opens up your PET for inspection.	
North Star	John Bryant	Backslashes to Colons	136
		Takes the tedium out of changing delimiters.	
TRS-80	Louis Graue	Which Way Is Best?	140
		Write a program to solve optimization problems.	
North Star	Stephen Lewis	Treat Your File Directory as Data	142
		Takes the guesswork out of disk file identification.	
PET	Garold Stone	Putting PET to the Test	146
		Cook's memory test is adapted for the PET.	
Heath	Charles Cohn	Heath's Hidden Time-Saver	150
		Give your printouts that up-to-date look.	

DEPARTMENTS

Publisher's Remarks-6	Dealer Directory-153
PET-pourri-9	Calendar-154
Dial-up Directory-14	Letters to the Editor-179
Computer Blackboard-20	Book Reviews-182
Micro Quiz-22	New Products-184
Micro-Scope-24	New Software-194
Editor's Notes-58	Conversions-198
Classifieds-153	Software Reviews-210

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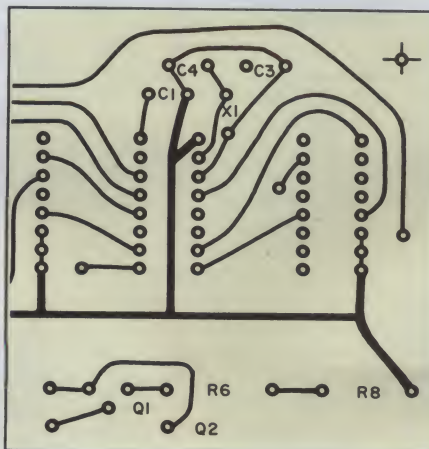
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Page 96.



Page 102.

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Computer Games Wear Thin

When Will The Industry Grow Up?

The Arcade Misunderstanding

Arcade games are a lot of fun. Even the early pong games were a ball. I remember spending hours slipping quarters into an Atari tank war game in Atlantic City during the first computer show there. But somehow the fun of the pong games didn't seem to carry over into playing them on my home television. Something got lost in the translation. The novelty and excitement of even the advanced color pong, with a half dozen different (but similar) games, only lasted a week or so.

Early computer hobbyists, remembering the fun of arcade games and having played Star Trek on a big computer, spent hundreds of dollars and hundreds of hours building a computer so they could play... only to become bored within a few days. Other hobbyists spent their time and money building a system to play the Game of Life, a real thriller—for an hour or two.

Apparently not aware of this syndrome, several firms have spent millions of dollars to bring computerized games to the public. The Mattel ads on television attempt to illustrate how much more wonderful their stick men playing baseball are than the Atari stick men. After the debacle with pong and super pong, I wonder how many people are going to shell out from a few hundred to a thousand dollars to play games. Is it really worth several hundred dollars to play computer hangman?

Games are still selling well for most systems, though even the best of the adventure games seem to wear thin after a few hours. Simulations seem to hold one's interest better than plain games, so I suspect that these will be improved and eventually replace most of today's games.

I don't have the fun playing against the computer (as in Star Trek) that I do

against people. I enjoy winning against people and get no particular thrill out of winning or losing to a computer. It isn't the same... any more than playing the tank game on my Atari at home is as much fun as shooting 'em up in an arcade—even at a quarter for a few minutes.

I'm much more interested and enthusiastic about computer applications. I enjoy seeing the sales curves of the various publications we put out, and like to keep track of the couple hundred projects which are moving along. I enjoy using the computer where it is doing work for me, but it gets switched off when it comes to games. Besides, how do I know that it *really* is choosing random numbers when it plays against me? Damned thing probably cheats. I don't trust 'em.

I get the same feeling in Vegas when I come up against a computerized one-armed bandit. With the old mechanical ones you could sort of forget that they, too, were programmed to screw you. With the computer bandits I don't ever forget that the screwing is inevitable.

The rage for those handheld computerized games is dying down. We'll get a better idea of where that is going when we see the Christmas sales reports. The manufacturers were griping last Christmas that the fad for these miniature games was fading.

Where will this leave Mattel, Bally, APF, Atari and the other computer firms which went for the game approach? Perhaps my own experience is not in the mainstream and there really are millions to be made selling expensive game computers as a continuing business. I would suggest that the firms in this part of the industry keep their sales research departments up to strength, watching for changes and keeping options open.

If I were on the board of directors of one of these firms I'd be pushing for business and educational applications just in case the system turned out not to be able to re-

place cards as an adult game. Me? I'll take a good game of Cribbage or Pitch anytime.

Show Births and Deaths

Was it only five years ago that we saw the first microcomputer show in the country? It seems like ages. It was in Atlantic City, then, as now, a tacky, run-down place to go. But everyone went, with chartered flights for hobbyists coming in from San Francisco. That was in August 1976... and it was there, incidentally, where *Microcomputing* was first announced. We had a booth at the show and sold over a thousand subscriptions.

Most of the firms which exhibited there are now long gone. They were, for the most part, run by hobbyists and succumbed to either too much or too little success. Apple, which had a table right across from our subscription booth, is still around. It was the first public showing of the Apple I, and Steve Jobs picked up about 20 orders from dealers... and was on his way.

The chap who put on the show tried it again the next year at Atlantic City, but it didn't do as well. Then he moved it to Philadelphia for three years, where it ran down even more. He didn't bother this year.

Most of the early computer shows have faded away as the interest moved from eager hobbyists to more sophisticated business and educational buyers. Now the shows are almost all local in nature, with a small group of computer stores and software firms exhibiting. The recent ones in Chicago and Washington were about typical... running perhaps 50-60 booths and pulling a fair crowd on Saturday.

Frantic show promoters have recruited all sorts of weird firms to flesh out their shows. We see condominium sales from Florida, encyclopedia sales, eyeglass



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cleaner chemicals, telephones, intercoms, office copiers, car gadgets, and so on... with the computer stores intermixed. We also see fewer and fewer of the larger firms bothering to exhibit at these shows. They've found that other forms of promotion are far more efficient in selling the product. Indeed, unless you have an extraordinary amount of profit in your product—and it is relatively low in price—shows can lose for you. Local dealers are often able to pick up customers, so they find shows pay off.

To you, the show goer, this means that you are not likely to see much more than you would visiting your local dealer, yet you'll be out around \$5 for the entry fee. Of course, if you are anxious to buy an encyclopedia at retail price, you're all set. I've found very few real bargains at shows in the last year or so. With booths costing around \$600 to \$1000 each, plus the cost of the exhibit and the people to man the booth, you can understand why bargains are not likely. They have to sell a bundle of stuff just to break even.

The word seems to have gotten around that shows can make the promoter rich, hence the proliferation of shows. A recent one in New York, run by a new show entrepreneur, was a disaster. Just about every major city has a show scheduled for this fall and next spring. It will be interesting to see if this settles in... or dies out.

Clive Alive!

One of the more interesting cultural micro events in recent times was the visit of Clive Sinclair to Boston, where he did a show and tell of his ZX-81 system.

At \$100 for the kit and \$150 for the assembled model, people have been buying the ZX-81 just for the hell of it. After all, outside of a lunch in New York, ten lunches in Peterborough or a hundred

One of the more interesting cultural micro events in recent times was the visit of Clive Sinclair to Boston.

lunches at home, what can you get for \$100 any more? So people have been buying these computers... mostly for fun. Some say they're for their kids.

This new micro-micro is selling like fish and chips in England. Clive said that he'd sold 30,000 of them there in August and 40,000 in September. They're being made by the Timex people for him, so he doesn't even have to cope with a factory and strikes.

The finished model has accounted for 85 percent of their sales in the U.K., so not many buyers are getting the experience of putting the kit together. Presumably they want to use it for something rather than learn about its construction.

Schools have been big purchasers, with over 2900 schools in the U.K. buying them so far... that's over half of the secondary schools in the country. Well, it is an economical way for a school to advertise that it has a microcomputer for the kids so they will become computer literate.

Clive showed a prototype of a printer which is in the works. It will type at about 50 characters per second, he says, and cost under \$100. It will print out the complete screen for you or list your data.

In the U.S. they are selling by mail only. The ads have already hit—two-page-spread color ads almost everywhere! They're looking to sell about 20,000 a month in the U.S. I don't think they will have any problem with that goal.

Microcomputing is interested in articles and programs on the ZX-81.... Let's get busy with this one.

Women and the Future

As the invasion of offices by microcomputers continues to expand, what have been considered women's jobs in the past will be hardest hit. Computerized data input will eliminate the need for rows of women doing data input typing. As word processors and electronic mail grow, the typing pool will dry up and even the secretary's responsibilities will diminish, leaving the women in that role either out of work or else needing retraining for some other position.

Will women cope with this by entering business in much the same way that men do, either by starting with a relatively menial job and working upward, or by getting a business education and starting in the middle? Perhaps we will be seeing more women in sales, marketing, advertising, PR, collections and other jobs which will be of increasing importance as computers take over the boring, repetitive work.

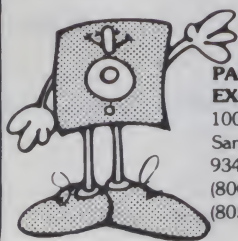
Just because people will not have to spend their lives doing boring work is no reason for them to drop out of work entirely.

Investing

Why should the banks be the only ones to get the gravy? Every now and then an investment opportunity comes up where someone could make the same interest as the banks are getting. It seems like a shame to have the banks making all the money. If you've got some extra money which you'd prefer to have working for you, drop a note to me and I'll pass it along to where it might do some good. □

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80-Column Adapter

Execom Corp. of Racine, WI, has announced an 80-column adapter upgrade for older 40-column PET/CBM systems. It can only be added on 2000, 3000 or 4000 series models that do not have the CRT display controller chip used in the newer systems. The upgrade consists of one two-inch-square logic board for both the 40- and 80-column screen editor ROMs, a 4x5 inch logic board that replaces the original screen RAMs and a separate 80-column reference ROM that can be located in any of the normal expansion sockets.

The circuit board and the ROM combination allows you to switch between the original 40-column display and a new 80-column display. The display selection can be made from the keyboard or through program control with two simple POKE commands. All utility soft-

ware, like Toolkit, DOS Support (Wedge), Extra-Mon, etc., is compatible in both modes of operation.

Price of the modification is \$275 plus installation. The actual installation involves cutting circuit traces on the main PET/CBM logic board, soldering additional wires to the circuit board and installing four new sockets. The installation should only be done by your local dealer or a qualified technician.

Execom Corp. will be offering the installation for \$75 (plus shipping), but you must remove your main logic board and return it to Execom Corp. Factory modifications must be prearranged before you can ship the board to them. Also, be aware that this installation may void Commodore's 90-day warranties on new systems. All Execom boards will have a one-year warranty.

Unfortunately, I haven't had the opportunity to see this installed in a system as

yet, so I can only pass on what information I have. For more information, see your local dealer or write Execom Corp., 1901 Polaris Ave., Racine, WI 53404.

Formatted Disk Files From Word Pro

I recently came across a Word Pro 3 feature that is hinted at in the manual but not fully explained. For those of you who are currently using Word Pro 3, there is a way to save the formatted output on disk in a sequential data file. There is another option to the output (Control-O) command that is not documented anywhere in the manual. The only options covered are the C for continuous output, G for global and X for multiple copies. The manual does explain how the formatted output will be written on the disk, but not how to generate the disk file.

All you have to do is enter a D option to the normal output command. Word Pro 3 will ask for a drive number and file name, and then write the formatted output to the specified file on disk. The file created will be a sequential data file that you can then use for input to other programs or utilities. Each formatted line is stored on disk as a single data record with a leading quote character. The normal carriage return is used to terminate the line. If multiple blank lines are generated using the LN or FP commands within Word Pro, then multiple carriage return characters will appear at the end of the last printed line.

I've included a program that will read and print the formatted data files created by Word Pro (see Listing 1). This program will handle all page formatting and line spacing correctly but it does not support expanded printing. Any expanded print output will be printed in reverse

```

100 REM *****
110 REM
120 REM UTILITY PROGRAM FOR PRINTING
130 REM FORMATTED OUTPUT DISK FILES
140 REM   CREATED BY WORD PRO 3.
150 REM
160 REM   BY: ROBERT BAKER
170 REM   15 WINDSOR DRIVE, ATCO, NJ
180 REM
190 REM *****
200 :
210 INPUT "FILENAME"; F$
220 F$=LEFT$(F$,16): S$=""
230 IF LEFT$(F$,2) <> "0:" AND LEFT$(F$,2) <> "1:" THEN F$="0:"+F$
240 OPEN 15,8,15
250 OPEN 8,8,8,F$+",S,R"
260 INPUT#15,EN
270 PRINT: IF EN=0 THEN 300
280 IF EN=62 THEN PRINT"FILE NOT FOUND": GOTO 370
290 PRINT"ERROR: ";EN: GOTO 370
300 PRINT"OK, READING FILE..."
310 OPEN 7,4,7: PRINT#7: CLOSE 7: REM PUT PRINTER IN UPPER/LOWER CASE MODE
320 OPEN 4,4
330 GET#8,C$: SS=ST
340 IF ASC(C$)=13 THEN PRINT#4,MID$(S$,2): S$="": GOTO 360
350 S$=S$+C$
360 IF SS=0 THEN 330
370 CLOSE 4: CLOSE 8: CLOSE 15
READY.

```

Listing 1. Utility program for printing formatted output disk files created by Word Pro 3.

Address correspondence to Robert W. Baker, 15 Windsor Dr., Atco, NJ 08004.

(normal size) on a Commodore printer. This may or may not cause problems.

When you run the program it simply asks for the filename of the file to be printed. A default drive number of zero is automatically assigned. You can indicate a specific drive number by preceding the filename by the drive number and a separating colon. You must, however, enclose the entire string within quotes when specifying the drive number. The program checks that the file exists and then proceeds to start printing each line from the data file. There is a short delay between printing each line, because a GET# command is used to read and check each character of the line. This allows checking for the multiple carriage returns that may exist at the end of any line.

If you think about the possibilities, this Word Pro feature is really valuable. You could create a software package with complete documentation, all formatted by Word Pro, but the user wouldn't need Word Pro to print his own manuals from disk. Actually, this is better than getting printed manuals since you can print as many copies as you want, as often as you want and you don't have to worry about losing your only copy.

Once you've gotten the formatted documentation onto disk as a sequential data file, you can easily copy it onto cassette tape. I've included a copy of my utility program for copying data files from disk to tape (see Listing 2). If you remember back in the Feb. 1981 column, I presented a program for copying tape data files onto disk. Well, this is the other program I mentioned in that column for copying data files back onto disk. It will work for any data file, not just the Word Pro formatted output files.

Once you've gotten the formatted output files on tape, you have to make a few changes to the first printing utility to read the data from tape instead of disk. I've included a copy of the print utility for printing from tape files (see Listing 3). Now you can get first-class formatted documentation without a disk or Word Pro, as long as you have a printer. Actually, you could modify the printing program to just display the information and you wouldn't even need a printer.

If you are writing a program that interfaces with Word Pro files, it may be easier to read these formatted output files instead of Word Pro source (input) files. Word Pro's source files use a special character encoding and have numerous commands within the text. Also, the source files are actually program files instead of sequential data files. The formatted output files have all the format commands removed and only contain the actual data. Everything is in the correct format and the data is now true ASCII coding. This should make the formatted output files easier to deal with.

This Word Pro output option opens a number of applications that many people

Now you can get
first-class formatted
documentation without a
disk or Word Pro.

may not have been aware of before. It might be interesting to see what we can do with it.

Jump Vectors

I thought it might be useful to list the jump vectors located at the top of memory in the VIC-20. The corresponding operating-system subroutines can be called by user-written machine-language programs or even from BASIC. I've included a brief description of the operation of each routine and the registers used. Many of these routines are the same as those used in PET/CBM machines, but the addresses may be slightly different. As such, this information should be of general interest. Note that addresses are shown in hexadecimal.

\$FF8A—Restore Old I/O Vectors. Restores default vector values for system subrou-

tines and interrupts.

\$FF8D—Read/Set Vectored I/O. If carry is set, the current contents of the RAM vectors are placed in a list pointed at by the X and Y registers. If carry is clear, the user list pointed at by the X and Y registers is transferred to the system RAM vectors.

\$FF90—Control Operating System Messages. Bits 6 and 7 of the accumulator enable the printing of control and error messages, respectively. If the bit is set then the messages will appear. \$FF93—Transmit Secondary Command. Transmits the value in the accumulator as a secondary IEEE address. This routine can only be called after commanding an IEEE to listen.

\$FF96—Send Secondary After Talk. Transmits the value in the accumulator as a secondary IEEE address. This routine can only be called after commanding an IEEE device to TALK.

\$FF99—Read/Set Top of Memory. If carry is set, the top of RAM memory pointer is returned in the X and Y registers. If carry is clear, the contents of the X and Y registers are transferred to the top of memory pointer.

\$FF9C—Read/Set Bottom of Memory. Same as the previous command except for the bottom of memory pointer.

\$FF9F—Scan Keyboard. Same routine as called by the interrupt handler to scan

```
100 REM *****
110 REM
120 REM   DISK-TO-TAPE DATA FILE COPY
130 REM
140 REM       BY: ROBERT BAKER
150 REM 15 WINDSOR DRIVE, ATCO, NJ
160 REM
170 REM *****
180 :
190 PRINT"INSERT BLANK TAPE IN TAPE#1"
200 PRINT"& DEPRESS ANY KEY WHEN READY"
210 GET R$: IF R$="" THEN 210
220 PRINT"OK": PRINT
230 OPEN 15,8,15
240 INPUT"DISK FILE NAME";FL$
250 PRINT"DRIVE# 0 OR 1: ";
260 GET D$: IF D$ <> "0" AND D$ <> "1" THEN 260
270 PRINT D$
280 OPEN 2,8,2,D$+":"+FL$+",S,R"
290 INPUT#15,EN,EM$: IF EN<>0 THEN 360
300 PRINT"OK": OPEN 1,1,1,FL$
310 PRINT: PRINT"COPYING DATA....."
320 GET#2,C$: S=ST
330 INPUT#15,EN,EM$: IF EN<>0 THEN 360
340 PRINT#1,C$;: IF S=0 THEN 320
350 PRINT: PRINT"DONE COPY": GOTO370
360 PRINT: PRINT"DISK ERROR": PRINT EN,EM$
370 CLOSE 1:CLOSE 2:CLOSE 15
READY.
```

Listing 2. Disk-to-tape data file copy.

the keyboard. If a key is down, its ASCII value is placed in the keyboard queue.

\$FFA2—Set Timeout on IEEE. A 0 in bit 7 of the accumulator enables timeouts, while a 1 disables timeouts on the IEEE bus. Timeouts are normally used to avoid hanging in a handshake sequence between devices on the bus.

\$FFA5—Input Byte from IEEE Bus. Handshakes a byte from the IEEE bus and returns the data in the accumulator. It is assumed that the device has been told to TALK.

\$FFA8—Output Byte to IEEE Bus. One byte of data is taken from the accumulator to handshake as data on the IEEE bus. A device must be listening or status will reflect a timeout. One character is always buffered by this routine. When the UNLISTEN subroutine is called, the buffered character is sent followed by the UNLISTEN command.

\$FFAB—Command IEEE Bus to Untalk.

\$FFAE—Command IEEE Bus to Unlisten.

\$FFB1—Command IEEE Device to Listen. The device number from the accumulator is ORed with bits to convert this device number to a listen address and then transmits the data as a command on the IEEE bus.

\$FFB4—Command IEEE Device to Talk. The device number from the accumulator is ORed with bits to convert this device number to a talk address, and it then transmits the data as a command on the IEEE bus.

\$FFB7—Read I/O Status Word. Returns the current I/O status in the accumulator. Values are the same as listed for ST in the Commodore manuals.

\$FFBA—Set Logical, First, Second Address. The accumulator contains the

logical file number used by the system to access data stored in a table by the open file subroutine. The X register contains the device number, while the Y register contains the command. The command is sent as a secondary address on the IEEE bus following the device number during an attention sequence. If no secondary address is to be sent, set Y to \$FF.

\$FFBD—Set File Name Information. Load the accumulator with the length of the file name, 0 if opening a file without a file name. The X and Y registers then contain the address of the actual character string corresponding to the file name.

\$FFC0—Open Logical File. Previous two subroutines must be called first (\$FFBA & \$FFBD).

\$FFC3—Close Logical File. Accumulator contains the logical file number of the file to be closed.

\$FFC6—Open Channel for Input. Opens a channel for input after being opened by the Open subroutine. This subroutine must be executed before attempting to read data from any device except the keyboard. This call may be omitted for keyboard input with no logical file number association.

\$FFC9—Open Channel for Output. Opens a channel for output after being opened by the Open subroutine. This subroutine must be executed before attempting to write data to any device except the display. This call may be omitted for output to the display with no logical file number association.

\$FFCC—Close Input and Output Channel. Closes all open channels and restores the default channels, input device 0 and output device 3.

\$FFCF—Input Character from Channel. Returns a character of data from the open

Note that addresses are shown in hexadecimal.

or default channel. The data is returned in the accumulator and the channel remains open after the call. For keyboard input, the cursor is turned on and continues to blink until carriage return is typed. Characters on the line are returned one by one by calls to this routine.

\$FFD2—Output Character to Channel. Sends a character of data to the open or default channel. The data is taken from the accumulator and may be transmitted to multiple devices on the IEEE bus.

\$FFD5—Load RAM from Device. Performs a load from a device if the accumulator is 0, a verify if a 1. The X and Y registers contain the starting address for the load if a secondary address of 3 is used. Otherwise, the block will load into memory starting at where the header has specified. On return the X and Y registers indicate the highest RAM address loaded.

\$FFD8—Save RAM to Device. Saves memory to a logical device from the bottom of memory pointer to the address pointed to by the X and Y registers.

\$FFDB—Set Real-Time Clock. The accumulator and the X and Y registers are loaded into the three-byte system clock.

\$FFDE—Read Real-Time Clock. Returns the current three-byte system clock value in the accumulator and the X and Y registers.

\$FFE1—Check Stop Key. Sets the Z flag if the stop key is pressed while the routine is called, and all other flags are maintained. If the stop key is not pressed, the accumulator will indicate the last row of the keyboard scan. This can be used to check for other key closures.

\$FFE4—Get Character from Keyboard Queue. Removes one character from the keyboard queue and returns as ASCII value in the accumulator. A 0 is returned if the queue is empty.

\$FFE7—Close All Files. The pointers into the open file table are reset, closing all files. All I/O channels are also reset.

\$FFEA—Increment Real-Time Clock. This routine is normally called every 1/60th of a second to update the system clock. It may be necessary to call this routine from a user's program if it processes its own interrupts.

\$FFED—Return X,Y Organization of Screen. Returns the organization of the screen with columns in X register and lines in Y register.

\$FFF0—Read/Set X,Y Cursor Position. If carry is set, the current cursor position is returned in the X and Y registers. If carry is clear, the cursor is moved to the position indicated by the X and Y registers.

\$FFF3—Return Base Address of I/O. Returns the address of the page containing I/O in the X and Y registers. □

```

100 REM *****
110 REM
120 REM UTILITY PROGRAM FOR PRINTING
130 REM FORMATTED OUTPUT DISK FILES
140 REM   CREATED BY WORD PRO 3
150 REM   THAT ARE COPIED TO TAPE
160 REM
170 REM       BY: ROBERT BAKER
180 REM   15 WINDSOR DRIVE, ATCO, NJ
190 REM
200 REM *****
210 :
220 PRINT"INSERT TAPE & DEPRESS ANY KEY WHEN READY"
230 GET C$: IF C$="" THEN 230
240 OPEN 1,1
250 PRINT: PRINT"READING FILE..."
260 OPEN 7,4,7: PRINT#7: CLOSE 7
270 OPEN 4,4
280 GET#1,C$: SS=ST
290 IF ASC(C$)=13 THEN PRINT#4,MID$(S$,2): S$="": GOTO 310
300 S$=S$+C$
310 IF SS=0 THEN 280
320 CLOSE 1: CLOSE 4
READY.

```

Listing 3. Utility program for printing formatted output disk files created by Word Pro 3 that are copied to tape.

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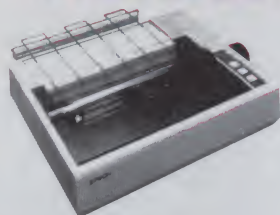
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Midnight Messenger

Unattended Transmission From Microcom

This edition of Dial-Up Directory marks the second anniversary of the column. Microcomputer-based data communications systems have evolved in a pretty straight line over those two years, but now we are starting to see some branching in the evolutionary tree. This month we'll look at a slightly different kind of electronic mail package, the first commercial adaption of an old idea.

Micro-Courier by Microcom

Micro-Courier is truly an electronic mail package. It provides the Apple II microcomputer with the ability to "wake up" in the middle of the night, dial a phone number, establish contact with another Micro-Courier-equipped Apple II and transfer messages.

In the June 1980 issue of *Kilobaud Microcomputing*, I described a program with similar capabilities called PAN. PAN is still available and costs about \$12 on cassette. PAN has never really been commercially marketed. It exists as a project of the Personal Computer Network (PCNET) in Menlo Park, CA. Micro-Courier sells for \$250 per copy (you need a separate copy at each end) and it is being heavily marketed.

This idea of unattended message transfer is as old as electronic communications. Before World War II, amateur radio operators developed radioTeletype systems using autostart tones. In response to a clock mechanism, a mechanical teleprinter would key up a radio transmitter, broadcast tones to wake up the teleprinter at the other end and transmit a prepunched message tape.

This kind of message transfer fits well into my concept of electronic communications systems that can break down the Time Tyranny of Telecommunications. Unattended message transfer lets people break away from the need to monitor a telephone or terminal to get a message. Several software firms are developing packages with slightly different unattended transfer capabilities, but Micro-Courier is the first one to be marketed on

a commercial basis.

Microcom has a very businesslike approach to their product. They are appealing to the corporate Apple rather than the Apple at home. Technically, the Micro-Courier package is a series of programs on an Apple II disk in DOS 3.3 format. The programs are in assembly language, and Microcom cautions that the disk is uncopyable. They also caution that attempts to copy the disk may result in its destruction. (A real mission impossible?) If you should set your coffee cup on the disk within 90 days of purchase, they will replace it for free. If the disk falls on the floor and you roll your chair over it on the 91st day, it costs you \$35 to replace.

The program selection is done through a series of menus which gradually lead you to the operating level. The program asks the user some questions the first time it is run so it knows where to look for the modem, clock and printer cards. It is easy to step down and up the menus to select the function you want. As you step through the menus, the selections you have made are displayed at the top of the screen (rather like a self-documenting game of adventure).

The manual stresses that all you have to do if you get into a problem is hit escape and you'll return to the next high-level menu. This works—most of the time.

The program works well doing what it is advertised to do: dropping off messages in the middle of the night when the rates are low. It will do this only with another Micro-Courier-equipped Apple II. Each system should have an Apple II+ or Apple II with Applesoft in ROM, 48K of RAM, a disk system with DOS 3.3 and a Hayes Microcomputer Products Micro-modem II. A clock card and two disks are really needed for practical operation. The Micro-Courier disk is nearly full and a separate data disk is needed.

In a typical application, the user creates a message with the Micro-Courier text editor or any editor that will create DOS 3.3 files. Messages can be up to 4000 characters in length. A separate address

file tells the system when and where to send specifically named messages. The "where" direction is given as a name or other easily-remembered term.

A separate mailbox ID file matches names to telephone numbers. It is possible to create distribution lists in which many phone numbers are collected under one ID. At the assigned time, the Apple II dials the number and transmits the specified message. It transmits one file per call. The program is not smart enough to ask if the called station has any mail coming back. The program will repeat unsuccessful attempts to deliver a message, and logs of outgoing and incoming messages are maintained.

Micro-Courier does have an interactive terminal mode, but this mode is quite difficult to use. The terminal mode has 22 lines available for the display of received data. The screen displays modem and file status in five lines at the top, and three lines of special commands you need to know are displayed at the bottom.

Unfortunately, the incoming data overwrites the first line of commands on the bottom of the screen and the rest of the information loses meaning.

This is particularly tricky because in this program ESCAPE does *not* work. You could pound the escape key all day and not get to a higher menu. It also doesn't help that when two Micro-Courier-equipped Apples are in the terminal mode, neither one echoes the other. That means you can't see what you are typing, unless you both work your way back up through two menus and select the full duplex mode. You are much better off dumping the Micro-Courier software and just using the Micro-modem II ROM program if you simply want to operate in the terminal mode without exchanging files.

Micro-Courier has been heavily advertised and its slick packaging matches its advertising. The manual contains 164 pages of text with a very good index and a small glossary. It contains illustrations of the keyboard and screen displays. The

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² TRS-80 is a registered trademark of Radio Shack, a Tandy Company.



The Prentice P212C is a microprocessor-controlled modem capable of 300- or 1200-bits-per-second operation. The first button on the right selects high- or low-speed operation. The other buttons select various test modes. Extensive diagnostics are built into this well-engineered device.

discussion in the manual is done at the most elementary level. In fact, the entire packaging concept of the program, from the multiple menus through to the language of the manual, is aimed at the novice user.

That's acceptable, but experienced users can get pretty exasperated with rigid menu structures and the need to

wade through lines of explanation to find a specific command. In Microcom's defense, they did provide a stick-on guide to the commands used in the editor program, but a separate instruction card summarizing all the commands would be valuable.

I believe that if Microcom is going to be successful in the corporate market, they have some work to do. One disk I received for evaluation had a bad sector and would not load the editor. The other package had an instruction manual with many of the pages uncut. But primarily, I feel the program needs some way of performing a quality-control check on the messages it transmits. Not all long-distance phone lines are created equal, and it is often worse to transmit garble than never to have transmitted at all.

Significantly, microcomputer programs exist which perform very nice line testing and transmission validation. The ST-80 software series written by Lance Micklus has a line-testing and character echo-check feature. Many programs like Crosstalk provide a protocol file transfer which ensures accurate transmission. Micro-Courier has none of these features. It is an expensive program with limited applications.

Dow Jones

The mailbag has reminded me that I

have never mentioned the Dow-Jones Information Service (DJIS), which is available to microcomputer data communications users. This service has a higher hourly rate than either The Source or CompuServe, but if you are a serious stock investor it provides lots of useful information. DJIS provides information on over 6000 stocks and securities listed on the New York, American, Midwest and Pacific stock exchanges and the over-the-counter market. If you live in a part of the country without a good newspaper, or if you like to follow "penny stocks" or over-the-counter stocks, this feature could be handy. All listings are delayed 15 minutes, but for 99.99 percent of us that represents real-time information.

DJIS has an involved pricing structure that depends on both the time of day and the kind of service used. During non-prime hours, using the price quote function can cost 15 cents per minute. Use of the historical Media General information file costs \$1 per minute during any time period. (Obviously, you don't want to browse too long.) The non-prime hours change with the time zones. The Pacific time zone is only non-prime from 8 PM until midnight. The Eastern time zone gets the low rates from 8 PM to 3 AM.

I find the historical information the most valuable feature of the DJIS. You can get good information on price-earnings ratios, price performance vs market performance and many other features. In addition, news stories and financial information are available from the *Wall Street Journal* and *Barron's*. Most people would find it more economical to get the general news from the financial journals and just use the DJIS for research on specific issues. The news stories do have a subject search capability and can present a summary of the article.

Anyone interested in the Dow-Jones Information Service should note that Radio Shack is offering one hour of DJIS time in their CompuServe membership packages. You get a binder with system information, membership on CompuServe and an hour of user time on both CompuServe and DJIS for \$19.95 (order catalog no. 260-2224).

You don't have to use a TRS-80 computer to take advantage of this package: any computer or terminal with communications capability can be used.

Videotex software packages for the TRS-80 Model I, Model II, Model III and Color Computer are available for \$29.95 at Radio Shack. These packages also include one hour on CompuServe and DJIS. The cassette-based Vidtex programs (the program name is slightly different from the package name) are easy to use and nicely integrated into the CompuServe and DJIS formats. They all allow interfacing with a printer to provide hard copy of the received information, but of course they don't let you create data files. You'll

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✓ 67

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need a more advanced terminal program to save the received data in files.

The Dow-Jones Information Service isn't for everyone but those who can use it will find it invaluable. The Radio Shack CompuServe membership package gives many folks the opportunity to try the DJIS at a reasonable price.

The Prentice P212C

You can lease a 212A 1200 bits per second modem from your local telephone company. It will cost you about \$40 a month plus an installation charge of \$80 or more. This installation usually includes an improved line from your location to the telephone office and a telephone instrument with a modem/voice switching arrangement.

Alternatively, you can buy your own 212A modem. You might do this if you are in a business and want to depreciate the equipment, or if you simply want to avoid the monthly payments. Let's take a look at the state of the art in 212 modems. I want to introduce you to one of the most sophisticated 212A modems, the Prentice P212C.

The P212C is a microprocessor-controlled device which will operate at 300 bits per second as a Bell 103 standard device and at 1200 bits per second using the 212 standard. It connects to the computer or terminal through a standard RS-

232C cable. It will auto-answer and adjust itself to the speed of the calling party.

This is a commercial-quality device built in a heavy metal cabinet with a husky power supply. It has a commercial retail price of about \$800. The P212C will do many nice things for its user. It features five different types of loopback circuitry including separate local tests of the analog and digital sections of the modem and tests which show the quality of the telephone circuit with the cooperation of the modem at the other end.

A 212 standard modem can be used over average telephone lines, but you get more reliable operation if you ensure that the signal levels transmitted and received by the modem fall within certain limits. Signals with levels too high or too low can easily cause errors in the four-level phase-shifted keying scheme used by 212 modems.

Proper installation requires a padding resistor in the telephone coupler or connecting cable to fine tune the audio level with the telephone office. Prentice can provide various cables to connect the P212C to the telephone system. A "permissive" cable lets you plug the modem directly into any standard voice jack. But the use of a standard jack is the easiest (and cheapest) method of installation. It will usually work, but the error rate depends upon the conditions between your

telephone and the central office.

Marketing Advice

Prentice has obviously targeted the commercial market with this high-quality device, but with a few changes they could open the small computer market too. A plastic cabinet and elimination of the fancy test features would be the first step. I would reassign the five buttons on the front as on/off, 300/1200 bits per second, orig/ans, half/full duplex and in/out.

If they could sell the consumer model P212XX at \$400 they would have a big place in the market. In the meantime, if you want to put some zip in your data communications, the Prentice P212C provides a well-engineered and reliable way to do it. Contact the Prentice Corporation, 266 Caspian Drive, Sunnyvale, CA 94086.

Your Help

This column would be much harder to write without the tidbits and tantrums I receive from readers. If you want to help make the third year of Dial-Up Directory even better than the first two, your news and views are needed. Send paper mail to PO Box 691, Herndon, VA 22070. Include a stamped envelope for replies. Send electronic mail to TCB967 on The Source, 70003.455 on CompuServe, or the AMRAD CBBS, 703-734-1387. □

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Hardware Is A Terrible Thing To Waste

The entrance of microcomputers into the country's classrooms has grown from a trickle to a roar. Will we soon see a flood? Is the microcomputer a soon-to-be-forgotten technological fad? Is it an ideal instructional tool? I'll discuss these and other questions as this column assesses the microcomputer's impact on instruction and then projects that impact into the near future.

What's Happening Right Now?

As in so many application areas, the gap between the potential and the reality of microcomputer software is enormous. This gap reminds me of the story about the German poet who was asked where he would choose to live if he knew the world was about to end. After very little deliberation, he responded that he would live only in England. Many were surprised by his rapid, decisive response. When his decision was questioned, he responded that England was a perfect choice because England has always been 100 years behind the rest of the world.

While the analogy is not perfect, the state of today's software does indeed trail the potential of today's hardware by many years. This is not news to those in the computer industry, but it is both news and a huge disappointment to educators who've only read of the computer's potential before finding a microcomputer in their classroom.

Colleges and universities are not yet in a position to help educators with their current and short-term needs for assistance. While there are certainly a few exceptions to such a general statement, the number of colleges able to offer teachers no more than FORTRAN, COBOL, assembly-language programming, or something equally inappropriate is distressing. The number of well-publicized but rarely open or accessible microcomputer laboratories and well-



funded software evaluation centers that just can't manage to produce evaluations is also distressing.

Perhaps such situations are unavoidable aberrations of rapidly changing technologies and honest intentions that badly underestimate the magnitude of the task at hand. Although the situation will eventually evolve into a more acceptable state, it is unfortunate that the vast majority of colleges and universities have been unable to respond to a readily definable, nationwide need.

Educators have become increasingly receptive to the idea of using microcomputers for instruction. The lack of support materials coupled with the ideas already discussed has often resulted in frustration. However, many educators have also become more sophisticated in their evaluation of microcomputer software and hardware. While they readily admit their knowledge is inadequate, there is movement in the right direction.

Part of this movement is the result of the evolving technology. Now that several microcomputers popularly used for instruction have been replaced by newer, only somewhat compatible models, educators find themselves in a

position of defending earlier purchases of what is now being incorrectly called "outmoded" equipment. For those who properly prepared for their initial purchase, this defense is trivial. For those who were not so well prepared, the defense has necessitated an overdue crash course in computer literacy.

Educators are beginning to realize the disadvantages of basing their local programs on a single brand of microcomputer. The advantages of a single-brand commitment are far outweighed by the disadvantages. For example, my choice for the ten best pieces of instructional microcomputer software involves four different microcomputers. Having only one brand available is a major restriction. Microcomputers are big business, and vendor stability cannot be assumed. Many sales and a few good products are not a guarantee that there will be a tomorrow. Explaining to a school board that the company who sold you all the microcomputers is out of business and the machines can no longer be serviced is not an enviable position, yet I suspect that is where many responsible for one-brand commitments will find themselves. For these and other reasons, educators seem to be broadening the base on which they're developing instructional programs.

IBM and Education

A look at today's role of microcomputers in instruction would be incomplete without acknowledging that industry continues to call many shots for education. Although clever advertising agencies would have us think otherwise, improving instruction is foremost in almost no one's mind as new products are conceived and developed. This is actually quite reasonable, just unfortunate. When you compare the size and available cash in the marketplaces, small business, education and home educators always finish last. When the cost of dealing with the marketplaces is also considered, the spectators have lost interest

Walter Koetke, Putnam/Northern Westchester BOCES, Yorktown Heights, NY 10598.

and gone home before educators finish the race.

Some months ago I had the opportunity to hear a discussion of research regarding reading comprehension. I liked many aspects of this presentation, including the fact that a microcomputer was only one of several tools being developed for the classroom teacher who must teach reading comprehension. An experienced, thoughtful researcher from IBM's Watson Research Laboratories, New York, made the point that research indicates two essential features for instructional microcomputers are voice output and touch-sensitive screens. The importance of color was unclear, since the research presented did not indicate that color would or would not significantly enhance instruction.

Shortly after this presentation, IBM announced its new Personal Computer, a machine with a very impressive list of features, including excellent color, but without voice output and a touch-sensitive screen. IBM has produced an excellent product, but the education marketplace was not high on its list of development priorities. The Personal Computer does not provide those features which IBM's own research considers essential for instruction.

Next time you hear someone moan that education should make as effective use of microcomputers as does small business, remember that the small businessman can select hardware and software packages designed with the needs of small business in mind, while educators are often faced with the task of selecting the best of what was designed for someone else.

As a final general observation, the instructional use of microcomputers seems to be moving away from the "local hero" doing his or her thing to a more structured system-wide approach. This follows quite naturally as administrators become uncomfortable with a proliferation of hardware without someone providing coordination and direction for its use. The same phenomenon is happening at the state level. With at least one state reporting that 95 percent of its public schools provide computing facilities, there are several states attempting to form minimum standards, create computer literacy objectives, set microcomputer standards and offer other evidence that they're on top of things.

It's significant that 12-18 months ago you could survey microcomputer use by calling a school district's central office for information. That is not often the case at present. Now such a survey would require a call to each building. Whatever the reason, I believe the growth of local "computer coordinators" should assist other educators as they too begin to use the computer to support instruction.

Let's focus on the evolution of microcomputer hardware as it pertains to instruction. As already mentioned,

IBM has entered the marketplace with a well-designed personal computer system. It has done so in a manner that illustrates the rapid change of the industry. The new IBM Personal Computer is its first "integrated" system, which means IBM has put its name on products produced by others. The IBM Personal Computer will be offered with software developed by others and marketed through Sears and other nontraditional outlets. The point is that the rapidly changing technology has put an industry leader in a position of catching up. I suspect it will do just that, since the IBM Personal Computer seems to have all the good features of the competition plus several terrific extras, an excellent service plan and a name that won't do any harm.

The IBM Personal Computer will have little direct impact in the education marketplace. Too many schools still purchase the least expensive machine and then later worry about software and other forms of support. The chances of large numbers of schools adopting one of the most expensive machines is extremely remote.

On the other hand, I suggest that IBM's

Educators are often faced
with selecting the best
of what was designed
for someone else.

Personal Computer will have a significant indirect impact on instructional microcomputers. As IBM establishes itself in the business market, it will do so partly by expanding that market, but also at the expense of current entries in that market. Should IBM seriously affect the market share of Tandy, Apple or Commodore, that impact is bound to be reflected in the educational marketplace. The next 12 months should be very interesting.

Why BASIC?

There are well-known and respected educators, including Seymour Papert, who contend that BASIC is not just a poor choice, but an impossible choice for many children. We don't use BASIC as the result of any research on learning or instruction. We use BASIC because that's what the computer industry chose to provide.

Logo is now available for the Texas Instruments 99/4A personal computer (versions for the Apple and Atari are expected to be released soon). If you're concerned with computer use in grades K through 3, you can do no better than Logo. If you don't have a TI computer already—an extremely likely

possibility—then here's your opportunity to demonstrate some of the merits of having more than one brand of microcomputer.

Try the following on your micro or even minicomputer.

```
10 FOR C=1 TO 100 STEP .1
20 PRINT I
30 NEXT I
```

I've run this on a great many computers of all sizes, and the TI 99/4A is only one of two computers that properly execute the program. There are several other standard examples of annoying round-off error that can be executed without error on the TI 99/4A. The ability to avoid such errors is a strong plus when dealing with younger children.

Another piece of hardware that seems to be slow getting off the ground is the Radio Shack Color Computer. With a 16K memory and Extended BASIC, this is a very nice instructional machine that hasn't found its way into many classrooms. That might be attributed to the huge lack of instructional software. As of this writing, even Radio Shack was offering only three packages that might be considered useful for instruction. A significant step for this computer is the availability of a disk drive. A complete system with disk costs about \$1500. This configuration has nearly all the ingredients for becoming a winner in the education market. I suspect, however, that this will not be the case.

Two of the reasons for my suspicion are the Atari 400 and 800 coupled with Atari's somewhat recent decision to actively pursue the educational marketplace. While other vendors are certainly interested in the educational marketplace, Atari is the only major hardware vendor that has targeted school and home applications as a primary rather than secondary objective.

That Atari is serious in this commitment is evidenced by their recently being awarded the MECC (Minnesota Educational Computing Consortium) microcomputer contract for the next three years. This contract was awarded to Apple for the preceding three years, and that contract and ramifications of it went a long way toward establishing Apple's niche in the education market. As the MECC contract includes the translation of nearly 100 programs to the Atari, this newcomer will have a very sound software base of interest to many schools.

An assessment of today's educational hardware would be incomplete without mentioning the Apple II and TRS-80 Model III/Model I. Certainly these machines are the dominant factors in today's educational market, and there is some excellent software available for each of them. Dollar for dollar, the disk-based Model III is hard to beat for a general-purpose application at home or school. Should Radio Shack lower the price of the disk and/or disk controller for the Model III, they may well continue their

dominance in the market.

Where does all this hardware leave the teacher? Are there some clear, unchallengeable choices of hardware? You must carefully evaluate how your application would be best implemented on the personal computers discussed. Just be sure that if your application includes the use of prepackaged software, then use that software once or twice before buying the hardware. Most dealers are more than happy to accommodate a reasonable request such as this if your decision to purchase hardware really does ride on the outcome.

As schools consider additional hardware purchases, I suggest they carefully consider the experience of others. Bargains are not always what they seem. For example, in which marketplace do you find cassette-based systems? The answer is in the hobbyist and school market. Business has never taken a cassette-based system seriously.

As educators have become familiar with the advantages and disadvantages of various microcomputers and peripherals, they've realized that the disadvantage of initial cost of a disk may well be offset by the many user advantages. Cassette-based systems really aren't appropriate for other than beginning programming classes. There are certainly some successful applications in other circum-

Cassette-based systems really aren't appropriate for other than beginning programming classes.

stances, but I suggest such success is achieved in spite of, rather than with help of, the hardware. You can't help but notice that as the market is becoming saturated with cassette-based systems, at least two major manufacturers have announced notably lower-priced disk systems.

Educators should reconsider any decision to purchase other than disk-based microcomputers for instruction. If you've just a small amount of money, add a disk to your present cassette system. The only exception would be the TRS-80 Model I. That is best left alone, since the newer disk systems are vastly improved on the Model III as well as on other brands.

The rapid proliferation of microcomputer hardware in schools continues at a rate that parallels or exceeds the proliferation in other areas. Whether this proliferation is good or bad may be debatable, but its existence is fact. There is a statistic somewhere that says 80 percent of the scientists that ever lived in the world

were alive in 1960. In a similar manner, I believe more computers were sold during 1981 than were sold in all previous years. There is every reason to believe that this same outrageous rate of growth will continue. The impact on education will certainly be even larger, but the nature of that impact has yet to be well defined.

Next month I'll continue to explore the current state and near future of instructional microcomputing, with the emphasis on software and advice regarding future planning. □

MICRO QUIZ

What Does This Program Do?

If the following program is executed with $LS = \text{"you,"}$ what will be the final value of P ? (An underscore represents a blank.)

```
SS = "ask_not_what_your_country_
      can_do_for_you_"
```

```
SS = SS + "ask_what_you_can_do_
          for_your_country"
```

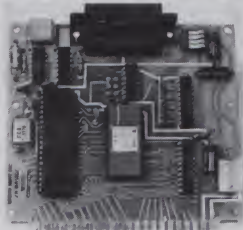
```
P = 0
```

```
for J = 1 to (len(SS)-len(LS))
```

```
  if mid$(SS,J,len(LS)) = LS then P = J
next J
```

(answer on page 153)

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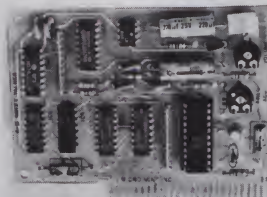
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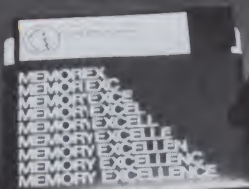
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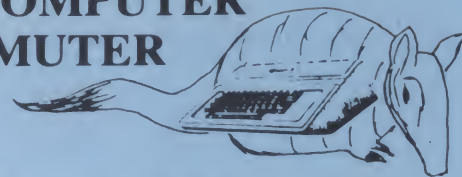
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Old MacDonald Had a Micro

And He's Using It To Call Up Videotext Services

Harvesting Data

Farmers, agriculturists and extension agents in the U.S. and Canada are making use of several specialized videotext services now on-line.

These services can provide a wide range of information, from current mar-

ket statistics to encyclopedic data on crop pests. They include the Kentucky Cooperative Extension Service's Green Thumb project, Instant Update from Professional Farmers of America in Cedar Rapids, IA, Elanco's Agrivision, Project Grassroots in Manitoba and SCAMP in New Hampshire and New York.

While they vary in size and scope, all use videotext technology, transmitting data via telephone line to a terminal or microcomputer.

The most popular type of videotext service so far is based on the Green Thumb project at the University of Kentucky. For that pilot test, Radio Shack developed a keypad which eventually evolved into the Radio Shack Videotex terminal. The project now also uses a TRS-80 Model II to collect and transmit data. The system has been adapted for use by Instant Update and Agrivision.

The initial phase of the Green Thumb project ran from March 1980 to December 1981. In January the Kentucky Extension Service moved into phase two, which was to establish Green Thumb as a permanent service. At first, some 200 farmers in two counties were able to access the service. In phase two, the service has been opened to the entire state.

Users can retrieve information in 17 categories, which include weather, market news, county news, pest management, agriculture economics, animal sciences, entomology, forestry, horticulture, plant sciences and veterinary medicine. The market and weather information is updated automatically; other categories are updated weekly or monthly.

The system consists of a TRS-80 Model II and an eight-line multiplexer. The service is free, except for phone charges. Eventually, different parts of the state will have their own store-and-forward

units, thus allowing farmers in each area to access the service with a local call.

While the Cooperative Extension Service provided the keypads for the pilot, farmers will now have to buy their own terminals or microcomputers. John Ragland, assistant to the director, says that software is available for the TRS-80s, the Apple and the TI 99/4.

Ragland expects that about one-third of the initial users will stay with the system, with perhaps a total of 200 users by next July. That number could multiply two or three times by mid-1983.

Instant Update

Instant Update is modeled closely after the Green Thumb project, and is the first commercial pay-as-you-go farmers' videotext service. It serves largely the Midwestern farm states, although it has subscribers in nearly all 50 states.

The core of Instant Update is an electronic newsletter that provides such ephemeral information as market news, commodity prices, marketing tips and the weather. Its features include:

- current future prices for grains, livestock, cotton and gold;
- a cash market scan that tracks the difference between cash and futures at key points for major crops;
- price chart trends;
- Washington Watch, for news from Pro Farmers' Washington bureau;
- a commodity-by-commodity summary of Pro Farmers' marketing plan;
- current recommendations on market tactics;
- local, national and world weather.

Instant Update currently has some 600 subscribers. "We consider that to be pretty good, even though it's not what we'd hoped for," says Marketing Manager Stewart Cross. Subscribers pay \$95 per month, plus toll charges. Cross says



the average subscriber calls twice a day and spends about \$30 a month on phone calls.

Instant Update subscribers originally were able to access the service only with a Radio Shack terminal. Pro Farmer has since developed software for the Apple, and is working on software for the TRS-80s.

Similar to Instant Update—in fact, Pro Farmer provides the editorial material—is Agrivision. Agrivision is provided by Elanco as a service to buyers of its herbicide trellan. Farmers who buy at least 250 gallons a year receive a terminal similar to the one used by Instant Update. The information, while similar to Instant Update's, is geared toward soy bean and cotton farmers in the South. So far, some 2000 units have been installed.

Except for phone charges, the service is free. Elanco provides the database partly to support its image as a "leader in innovation," says Roger Benson, manager of managerial services.

"Hopefully we'll gain a certain amount of market loyalty," he says.

Canada's Telidon system made its agricultural debut in mid-1981 with Project Grassroots in Manitoba. Growing out of the Project Ida field trial in South Headingley, near Winnipeg, Project Grassroots is a joint undertaking of InfoMart and the Manitoba Telephone System.

The project started off with 25 terminals in such public places as the offices of grain elevator operators, crop insurance agents and agricultural agents. It has since expanded to include 25 farm homes and 25-30 commercial subscribers, and InfoMart Branch Manager Bruno Leps hopes for 500 more terminals by early 1982 and 1500 more during the year after that.

Project Grassroots includes some 3500 pages of agricultural information. Included are the Winnipeg Commodity Exchange; the World Weatherwatch; information on home economics and farm safety; Current Focus, a service to provide regular updates on the market outlook for grain, livestock, dairy and poultry producers; the Herald Grain Newsletter, on grain industry activities for the week; statistical reports from the Canadian Grain Commission on the supply and movement of Canadian grain; and information on livestock markets.

To access Project Grassroots, the user needs a Telidon keypad, developed by Norpak, and the Telidon terminal from InfoMart. The user pays \$47 a month for the terminal on a two-year lease, and pays five cents a minute for telephone charges. Leps says that the average user spends ten to 20 minutes a day on the system, with monthly charges coming to about \$80.

One of the outstanding characteristics of Project Grassroots is its graphics displays. Grassroots pages often include colorful illustrations, charts and maps.

The SCAMP system differs from the others in that it is currently geared primarily toward extension agents, agriculturalists and foresters. It provides pest and crop management information, which is routed through the state extension agencies to the farmers.

The New Hampshire SCAMP program has some 60 users, most of whom are extension agents, University of New Hampshire personnel and foresters. But, says UNH Extension entomologist James S. Bowman, the long-range plans are to include individual farmers.

"There's no reason why a farmer couldn't hook up to the system if he had a coupler and terminal," he says.

The two most important features of SCAMP are its electronics bulletin board system and its library. The bulletin board includes field reports from SCAMP users on current pest problems and recommendations on how to deal with them. The library includes the life histories of a variety of crop pests, and information on their control.

Bowman is pleased so far with the system's development.

"The mechanics are good, and the software is fine," he says. "We just have to get people to use it more. The younger extension agents are embracing it, but some of the older agents are a little hesitant."

Market Strategies

To whom are these systems geared, and what is the potential market?

So far, the commercial services are appealing to owners of larger farms. The av-

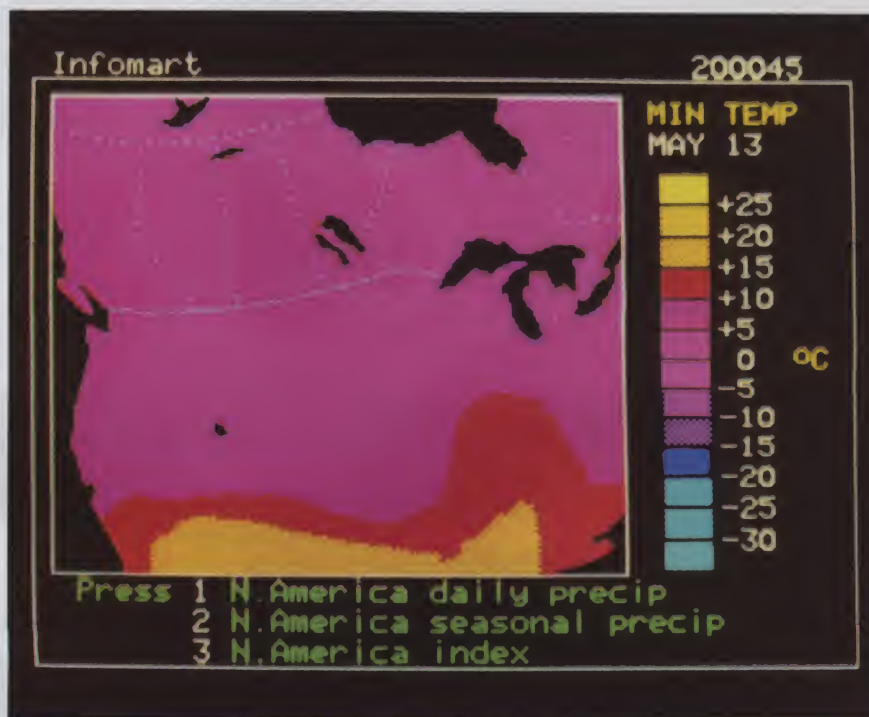
erage Instant Update subscriber, for instance, runs a 700-800 acre farm, substantially above the national average of 430 acres, and spends about \$125 a month on the service. Elanco subscribers receive the service free, but the 250 gallons of trellan they buy costs over \$6000 and is enough to treat 1000 acres. Bruno Leps says that Project Grassroots, too, is geared toward the larger farmer.

"This is not to say that there's not a market for others," he adds. "But we're going to have to bring the price down first."

The cost, however, is not the major factor, says Green Thumb's John Ragland. The costs for a terminal are within the reach of even the small farmer. "But you have to have some size before you start trading grain and livestock," he says, noting that marketing information is the most-used service of Green Thumb.

"It doesn't have to be the case that we're used only by larger farms," he continues. "If we get a bulletin board system, if we're imaginative and aggressive, we could come up with a service of value to small farmers, too."

Nevertheless, it is true that many small farmers are currently struggling for survival. According to figures from the U.S. Department of Agriculture, 102,000 farms have shut down in the U.S. since 1975, though the average size has increased from 420 to 430 acres. Many small farmers might not be willing to pay for a service like Instant Update, when they can get much of the same information in periodicals, on the radio and through the local extension agent.



A page from Project Grassroots, an agricultural videotext service in Manitoba, Canada.

A recent survey by *Successful Farming* magazine of its readership shows that 31 percent of those questioned are not interested in a videotext service. Some 41 percent said they are somewhat interested. Only 27 percent said they are interested or very interested. While this figure translates into some 650,000 potential subscribers—more than enough to make services like Instant Update commercially viable—it indicates that the majority of farmers will continue as they have for a while longer.

Bringing down the costs of videotext services will no doubt help. As Ragland points out:

"Farmers have traditionally had technology and information provided in fairly good quality and quantity for low cost, through extension agencies and the federal government. It's a fact that leads me to believe that we should look at alternative means of providing the information without charging the farmer a user's fee."

Several ways of doing this present themselves. Some companies could go the route of Elanco, offering videotext services as premiums to customers. Another possibility is sponsorship of databases by commercial businesses, an option Green Thumb is considering.

"For example, it might be a local county bank," Ragland says. "They may support a service in exchange for a page of information on their interest rates or services. It may be that there might have to be advertising, or at least recognition of sponsorship."

We should look at
alternative means
of providing the information
without charging the farmer
a user's fee.

Finally, extension agencies might act as clearinghouses for farmers in their area, as is the case with SCAMP. Farmers would call their local agent with questions, and the agent would access the information from the host computer.

Until the costs decline and services become accessible to a broader range of farmers, videotext services will be scrambling to convince their potential market that they have a valuable product.

"Videotext is limited by how good the information is," Roger Benson of Elanco says. "As long as it's expensive to access the information, it has to be worth the customer's while."

—Eric Maloney

More on Woman Computerists

Microcomputing and the Association of Women in Computing have received a number of queries concerning an article on that organization (see "Women,

Unite!" on p. 28 of the October issue). Following is a list of chartered or provisional AWC chapters:

Washington, DC area

Linda Zenker
4905 Americana Drive, #111
Annandale, VA 22003
232-797-5338

Twin Cities

Bonnie Swierzbini
PO Box 14605
University Station
Minneapolis, MN 55414
612-482-1657

Greater Boston

Marcia J. Weston, vice-president
81 Leland Farm Road
Ashland, MA 01721
617-891-2226
Call Mon.-Thurs. only

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Linda A. Kane
302 Hartford Place
Utica, NY 13502

Los Angeles

Carol A. Grosvenor, president
PO Box 43677
Los Angeles, CA 90043
213-673-0986

New York Metropolitan

Brenda Pena, president
Box B
67-09 136th St.
Flushing, NY 11367
212-244-4270

St. Louis

Rita Sisul, acting president
Box 12907
St. Louis, MO 63141
314-925-5291

Puget Sound

Susan Pietrowski
16602 NE 18th St.
Bellevue, WA 98008

Women who are not near a chapter can get a list of members in their immediate areas by writing National President Linda Taylor, 3573 Greenfield Ave., Los Angeles, CA 90034 (213-557-8797).

The AWC was formed to support women in computer fields with career counseling and a network of job contacts, as well as seminars, workshops and scholarships.

The Rich Get Richer

The affluence of a school and its community is the most important factor in whether a school uses computers for instruction, says a recent study by Market Data Retrieval of Westport, CT.

The study says that 46 percent of those school districts spending over \$75 per student for instructional materials have instructional computers as compared to 20 percent of those spending under \$30 per student. Thirty percent of the schools in upper income areas use computers for instruction, as compared to 12 percent of low-income area schools.

=>VEGETABLE
HOW MANY DAYS TO REPORT?
=>7
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TO: FIELD

FROM 8/11/81 INSECT NOTES

VEGETABLES
(Bowman, Eaton)

Cole Crops: Cabbage looper MOTH CATCHES IN PHEROMONE TRAPS ARE STILL ZERO ON DOVER POINT BUT ARE INCREASING TO ABOUT ONE PER DAY IN STRATHAM. STILL NO APPARENT BUILD UP OF LARVAE. SCOUTING HAS DEMONSTRATED AS HIGH AS 56% OF THE PLANTS WITH AT LEAST ONE WORM WHICH IS PREDOMINANTLY THE Imported cabbage worm. AN UNEXPECTED ATTACK BY Japanese beetles ON COLE CROPS OCCURRED ON DOVER POINT THIS WEEK.

Potatoes: Colorado Potato beetle HAS BEEN SLOW BUILDING UP IN COMMERCIAL PLANTINGS SO FAR. PYDRIN HAS ELIMINATED MOST OF THE PROBLEM BUT WE HAVE NOTICED A SLOW BUILD UP IN UNTREATED AREAS ALSO. THIS IS PROBABLY DUE TO THE EXCELLENT GROWING CONDITIONS THIS YEAR. NO PROBLEMS WITH aphids or potato leafhopper SO FAR.

Sweet corn: SINCE OUR INITIAL CATCHES OF corn earworm and fall armyworm MOTHS REPORTED LAST WEEK, WE HAVE FOUND NO MORE OF EITHER SPECIES. A COUPLE OF EARWORMS WERE TRAPPED AT THE SUBURBAN EXPERIMENT STATION (WALTHAM, MASS.) THIS WEEKEND. GROWERS WITH LIGHT TRAPS MUST BE SURE THAT THE TRAPS ARE KEPT CLOSE TO FRESH SILKING CORN, IF EARWORM CATCHES ARE TO BE RELIABLE. European corn borer CATCHES ARE STILL HIGH. WE STILL RECOMMEND ABOUT A 6-DAY SCHEDULE FOR SILKING CORN, BUT THAT CAN CHANGE IF earworm or fall armyworm COUNTS INCREASE.

END

From the electronic bulletin board of the University of New Hampshire's SCAMP system.

The study also reports that of 15,442 U.S. school districts, 6441, or 42 percent, use instructional computers. Also, 15,918 of 84,226 public school buildings—or 19 percent—have classroom computers.

Grade level and size of the school are also factors. Some 43 percent of senior high schools, 26 percent of junior high schools and 12 percent of elementary schools use computers. Almost 60 percent of high schools with over 1000 students have computer-aided instruction, as compared to 24 percent of small high schools.

World Book On Line

The CompuServe Information Service will soon be offering an electronic version of the World Book Encyclopedia to its subscribers.

The encyclopedia, which is still in the developmental stage, will offer the basic editorial content of the printed version, as well as several enhancements.

"As the project develops I wouldn't be surprised if the encyclopedia includes extras, in the form of customer feedback where they could ask questions," says Richard A. Baker, CompuServe's editorial director. "Or World Book may break out certain sections of the Encyclopedia to be continually updated and revised."

This latter feature, he says, could provide current information on rapidly changing events in the world.

Baker says that these possibilities are based on the kinds of services other information providers like to include.

No date has been set for start-up of the encyclopedia.

A Boost for Atari?

Atari is going to give Apple and Tandy some stiff competition as a result of Sears' and IBM's decision to sell the 800 in their business machine stores, says a recent report from International Resource Development, Inc.

The report says that Atari, a division of Warner Communications, has recognized the importance of reaching the business market, and will thus gain a significant market share.

Throw That Kid an Atari

Twenty-one outstanding freshmen at Rensselaer Polytechnic Institute in Troy, NY, have received Atari 800 computer systems as part of an academic scholarship program.

The winners—15 men and six women—were chosen on the basis of academic achievement and Scholastic Aptitude

Test scores. Their SAT averages were 732 out of 800 for verbal and 761 of 800 for math.

The students can use their micros for special projects and compete for a \$1000 prize to be awarded at the end of the academic year.

The Ataris will become the students' personal property when they receive their undergraduate degrees.

RPI has developed an extensive computer education program, which includes an IBM 3033 mainframe and 400 terminals on campus.

New Mag for Big Blue

IBM's new Personal Computer was barely on the loading docks when Software Communications, Inc., revealed plans to launch a magazine for the computer.

PC, billed as "the independent guide to the IBM Personal Computer," will be piloted by David Bunnell. Bunnell, who most recently was managing editor at Osborne/McGraw-Hill, was also editor at one time of *Personal Computing* magazine, and has coauthored a book with Adam Osborne called *A Beginner's Guide to Microcomputers*.

Software Communications gave no date for publication of the new magazine. □

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Rubik's Cube Demystified

By Curtis and Lillian J. Cooper



Screen display of the Applesoft Rubik's Cube program. (Photo by Harold Nelson)

Program listing. Rubik's Cube simulation in Applesoft BASIC.

```
10 PRINT "THIS PROGRAM SIMULATES RUBIK'S CUBE"
20 REM
30 REM INITIALIZE RUBIK'S CUBE
40 REM
50 DIM R(5,5,5),R1(5,5,5),A(5,5),B(5,5),C(5,5),D(5,5)
60 FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
70 R(I,J,K) = 0
80 NEXT K: NEXT J: NEXT I
90 FOR I = 2 TO 4: FOR J = 2 TO 4
100 R(1,I,J) = 1: R(I,1,J) = 15: R(I,J,1) = 4
110 R(5,I,J) = 9: R(I,5,J) = 2: R(I,J,5) = 13
120 NEXT J: NEXT I
130 REM
140 REM MIX RUBIK'S CUBE
150 REM
160 INPUT "INPUT NUMBER OF MIXES";N
170 Z$ = ""
180 FOR I = 1 TO N
190 X = INT (6 * RND (1)): Y = INT (3 * RND (1))
200 IF X < > 0 THEN 220
210 X$ = "R": GOTO 310
220 IF X < > 1 THEN 240
230 X$ = "F": GOTO 310
```

More

This program, in Applesoft BASIC using low-resolution graphics, simulates Rubik's Cube. The problem is to take any arrangement of the cube and restore it to its pristine state.

In solving Rubik's Cube, each face on the cube can turn clockwise or counterclockwise. In addition, different views of the cube are obtained by rotating the cube about axes through the center squares of the top and bottom faces, right and left faces, and front and back faces.

Program Notes

The program uses an array R, dimensioned to 5 by 5 by 5, as its representation for Rubik's Cube. Colors are stored numerically as follows:

Magenta 1
Orange 9
Blue 2
Green 4
White 15
Yellow 13.

The F face (see photo for face identification) is stored in the middle 3 by 3 squares where $x=1$. The R face is stored in the middle 3 by 3 squares where $y=1$. The D face is stored in the middle 3-by 3 squares where $z=1$. Similarly, the B face is stored in the middle 3 by 3 squares where $x=5$; the L face is stored in the middle 3 by 3 squares where $y=5$; and the U face is stored in the middle 3 by 3 squares where $z=5$.

Address correspondence to Curtis and Lillian J. Cooper, 803 E. Clark, Warrensburg, MO 64093.

The program contains two big subroutines. One subroutine is used to rearrange the cube. The following notation, similar to that in James F. Nourse's *The Simple Solution to Rubik's Cube*, is used by the program to change the cube.

Summary of Moves

R+—Turn R face one quarter turn clockwise

R—Turn R face one quarter turn counterclockwise

R2—Turn R face one half turn

F+—Turn F face one quarter turn clockwise

F—Turn F face one quarter turn counterclockwise

F2—Turn F face one half turn

L+—Turn L face one quarter turn clockwise

L—Turn L face one quarter turn counterclockwise

L2—Turn L face one half turn

D+—Turn D face one quarter turn clockwise

D—Turn D face one quarter turn counterclockwise

D2—Turn D face one half turn

U+—Turn U face one quarter turn clockwise

U—Turn U face one quarter turn counterclockwise

U2—Turn U face one half turn

B+—Turn B face one quarter turn clockwise

B—Turn B face one quarter turn counterclockwise

B2—Turn B face one half turn

MFR# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the up (top) and down (bottom) faces. Move F to R face 1, 2, or 3 times.

MFU# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the right and left faces. Move F to U face 1, 2, or 3 times.

MUR# where # is 1, 2, or 3—Rotate the cube about the axis passing through the center squares of the front and back faces. Move U to R face 1, 2, or 3 times.

Several moves can be performed on the cube by concatenating together any of the above moves.

The second subroutine draws the cube. Two views are displayed on the screen. The first view shows the corner formed by the up, right and front faces as the corner closest to the viewer. The second view has the opposite corner (formed by the down, left and back faces) closest to the viewer. The faces are each labeled (see photo).

The program begins by initializing the cube and asking how many moves you want it to make to mix up the cube. It is then randomly mixed the number of times specified and the resulting cube is displayed. The program asks you to input your move or moves. Invalid move entries are rejected and you are asked to reenter your move. If S is input, the program stops. Otherwise the resulting cube is displayed and another move is requested.

quested.

Enjoy exploring this color-graphics version of Rubik's Cube. ■

References

Nourse, James G. *The Simple Solution to Rubik's Cube* (New York: Bantam Books, 1981).

Singmaster, David. *Notes on Rubik's 'Magic Cube'* (Hillside, New Jersey: Enslow Publishers, 1980).

Listing continued.

```

240 IF X < > 2 THEN 260
250 X$ = "L": GOTO 310
260 IF X < > 3 THEN 280
270 X$ = "U": GOTO 310
280 IF X < > 4 THEN 300
290 X$ = "B": GOTO 310
300 X$ = "D"
310 IF Y < > 0 THEN 330
320 Y$ = "+": GOTO 360
330 IF Y < > 1 THEN 350
340 Y$ = "-": GOTO 360
350 Y$ = "2"
360 Z$ = Z$ + X$ + Y$
370 NEXT I
380 GOSUB 500
390 GOSUB 2050
400 REM
410 REM CHANGE RUBIK'S CUBE
420 REM
430 INPUT "INPUT MOVE "; Z$
440 GOSUB 500
450 GOSUB 2050
460 GOTO 430
470 REM
480 REM PERFORM MOVES
490 REM
500 FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
510 R(I,J,K) = R(I,J,K)
520 NEXT K: NEXT J: NEXT I
530 IF Z$ = "" THEN RETURN
540 X$ = MID$(Z$,1,1)
550 IF X$ = "S" THEN 3100
560 IF X$ = "M" THEN 1250
570 REM
580 REM MOVE FACES
590 REM
600 Y$ = MID$(Z$,2,1)
610 IF X$ < > "R" THEN 710
620 FOR I = 1 TO 5: FOR J = 1 TO 5
630 A(I,J) = R(I,1,J): B(I,J) = R(I,2,J)
640 NEXT J: NEXT I
650 GOSUB 1720
660 IF E = 1 THEN 1670
670 FOR I = 1 TO 5: FOR J = 1 TO 5
680 R(I,1,J) = A(I,J): R(I,2,J) = B(I,J)
690 NEXT J: NEXT I
700 GOTO 1200
710 IF X$ < > "F" THEN 810
720 FOR I = 1 TO 5: FOR J = 1 TO 5
730 A(I,J) = R(1,1,J): B(I,J) = R(2,1,J)
740 NEXT J: NEXT I
750 GOSUB 1800
760 IF E = 1 THEN 1670
770 FOR I = 1 TO 5: FOR J = 1 TO 5
780 R(1,1,J) = A(I,J): R(2,1,J) = B(I,J)
790 NEXT J: NEXT I
800 GOTO 1200
810 IF X$ < > "L" THEN 910
820 FOR I = 1 TO 5: FOR J = 1 TO 5
830 A(I,J) = R(1,5,J): B(I,J) = R(1,4,J)
840 NEXT J: NEXT I
850 GOSUB 1800
860 IF E = 1 THEN 1670
870 FOR I = 1 TO 5: FOR J = 1 TO 5
880 R(1,5,J) = A(I,J): R(1,4,J) = B(I,J)
890 NEXT J: NEXT I
900 GOTO 1200
910 IF X$ < > "B" THEN 1010
920 FOR I = 1 TO 5: FOR J = 1 TO 5
930 A(I,J) = R(5,1,J): B(I,J) = R(4,1,J)
940 NEXT J: NEXT I
950 GOSUB 1720
960 IF E = 1 THEN 1670
970 FOR I = 1 TO 5: FOR J = 1 TO 5
980 R(5,1,J) = A(I,J): R(4,1,J) = B(I,J)
990 NEXT J: NEXT I
1000 GOTO 1200
1010 IF X$ < > "U" THEN 1110
1020 FOR I = 1 TO 5: FOR J = 1 TO 5
1030 A(I,J) = R(I,J,5): B(I,J) = R(I,J,4)
1040 NEXT J: NEXT I
1050 GOSUB 1720
1060 IF E = 1 THEN 1670
1070 FOR I = 1 TO 5: FOR J = 1 TO 5

```

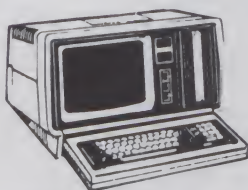
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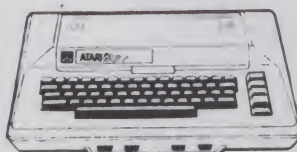
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Listing continued.

```

1080 R(I,J,5) = A(I,J):R(I,J,4) = B(I,J)
1090 NEXT J: NEXT I
1100 GOTO 1200
1110 IF X$ < > "D" THEN 1670
1120 FOR I = 1 TO 5: FOR J = 1 TO 5
1130 A(I,J) = R(I,J,1):B(I,J) = R(I,J,2)
1140 NEXT J: NEXT I
1150 GOSUB 1800
1160 IF E = 1 THEN 1670
1170 FOR I = 1 TO 5: FOR J = 1 TO 5
1180 R(I,J,1) = A(I,J):R(I,J,2) = B(I,J)
1190 NEXT J: NEXT I
1200 Z$ = MID$(Z$,3)
1210 GOTO 530
1220 REM
1230 REM CHANGE VIEWING CORNERS
1240 REM
1250 X$ = MID$(Z$,2,1):Y$ = MID$(Z$,3,1)
1260 S$ = MID$(Z$,4,1)
1270 IF S$ < > "1" AND S$ < > "2" AND S$ < > "3" THEN 1670
1280 N = VAL(S$)
1290 IF X$ < > "F" THEN 1540
1300 IF Y$ < > "R" THEN 1420
1310 Z$ = MID$(Z$,5)
1320 FOR K = 1 TO N
1330 Z$ = "U-D-" + Z$
1340 FOR I = 1 TO 5: FOR J = 1 TO 5
1350 A(I,J) = R(I,J,3)
1360 NEXT J: NEXT I
1370 FOR I = 1 TO 5: FOR J = 1 TO 5
1380 R(6 - J,1,3) = A(I,J)
1390 NEXT J: NEXT I
1400 NEXT K
1410 GOTO 530
1420 IF Y$ < > "U" THEN 1670
1430 Z$ = MID$(Z$,5)
1440 FOR K = 1 TO N
1450 Z$ = "R+L-" + Z$
1460 FOR I = 1 TO 5: FOR J = 1 TO 5
1470 A(I,J) = R(I,3,J)
1480 NEXT J: NEXT I
1490 FOR I = 1 TO 5: FOR J = 1 TO 5
1500 R(J,3,6 - I) = A(I,J)
1510 NEXT J: NEXT I
1520 NEXT K
1530 GOTO 530
1540 IF X$ < > "U" THEN 1670
1550 IF Y$ < > "R" THEN 1670
1560 Z$ = MID$(Z$,5)
1570 FOR K = 1 TO N
1580 Z$ = "F+B-" + Z$
1590 FOR I = 1 TO 5: FOR J = 1 TO 5
1600 A(I,J) = R(3,I,J)
1610 NEXT J: NEXT I
1620 FOR I = 1 TO 5: FOR J = 1 TO 5
1630 R(3,6 - J,1) = A(I,J)
1640 NEXT J: NEXT I
1650 NEXT K
1660 GOTO 530
1670 PRINT "INVALID MOVE, TRY AGAIN."
1680 FOR I = 1 TO 5: FOR J = 1 TO 5: FOR K = 1 TO 5
1690 R(I,J,K) = R(I,J,K)
1700 NEXT K: NEXT J: NEXT I
1710 RETURN
1720 E = 0
1730 IF Y$ < > "+" THEN 1750
1740 GOSUB 1950: RETURN
1750 IF Y$ < > "-" THEN 1770
1760 GOSUB 1880: RETURN
1770 IF Y$ < > "2" THEN 1790
1780 GOSUB 1880: GOSUB 1880: RETURN
1790 E = 1: RETURN
1800 E = 0
1810 IF Y$ < > "+" THEN 1830
1820 GOSUB 1880: RETURN
1830 IF Y$ < > "-" THEN 1850
1840 GOSUB 1950: RETURN
1850 IF Y$ < > "2" THEN 1870
1860 GOSUB 1880: GOSUB 1880: RETURN
1870 E = 1: RETURN
1880 FOR I = 1 TO 5: FOR J = 1 TO 5
1890 C(I,J) = A(I,J):D(I,J) = B(I,J)
1900 NEXT J: NEXT I
1910 FOR I = 1 TO 5: FOR J = 1 TO 5
1920 A(6 - J,1) = C(I,J):B(6 - J,1) = D(I,J)
1930 NEXT J: NEXT I
1940 RETURN
1950 FOR I = 1 TO 5: FOR J = 1 TO 5
1960 C(I,J) = A(I,J):D(I,J) = B(I,J)
1970 NEXT J: NEXT I
1980 FOR I = 1 TO 5: FOR J = 1 TO 5
1990 A(J,6 - I) = C(I,J):B(J,6 - I) = D(I,J)
2000 NEXT J: NEXT I
2010 RETURN
2020 REM
2030 REM PRINT RUBIK'S CUBE
2040 REM
2050 TEXT
2060 GR
2070 COLOR= 0
2080 X1 = 9:Y1 = 39:X2 = 6:Y2 = 36:X3 = 3:Y3 = 33:X4 = 0:Y4 = 30:W2 = 12:W3 = 15
:W4 = 18
2090 FOR I = 0 TO 15
2100 PLOT X1,Y1 - I: PLOT X2,Y2 - I: PLOT X3,Y3 - I: PLOT X4,Y4 - I: PLOT W2,Y2
- I: PLOT W3,Y3 - I: PLOT W4,Y4 - I
2110 NEXT I

```

More


```

2120 X1 = 9:Z1 = 39:Z2 = 34:Z3 = 29:Z4 = 24:Y2 = 21:Y3 = 18:Y4 = 15
2130 FOR I = 0 TO 9
2140 PLOT X1 + I,Z1 - I: PLOT X1 + I,Z2 - I: PLOT X1 + I,Z3 - I: PLOT X1 + I,Z4
- I
2150 PLOT X1 - I,Z1 - I: PLOT X1 - I,Z2 - I: PLOT X1 - I,Z3 - I: PLOT X1 - I,Z4
- I
2160 PLOT X2 + I,Y2 - I: PLOT X3 + I,Y3 - I: PLOT X4 + I,Y4 - I
2170 PLOT W2 - I,Y2 - I: PLOT W3 - I,Y3 - I: PLOT W4 - I,Y4 - I
2180 NEXT I
2190 X1 = 30:X2 = 27:X3 = 24:X4 = 21:Y1 = 21:Y2 = 24:Y3 = 27:Y4 = 30:W2 = 33:W3
= 36:W4 = 39
2200 FOR I = 0 TO 15
2210 PLOT X1,Y1 - I: PLOT X2,Y2 - I: PLOT X3,Y3 - I: PLOT X4,Y4 - I: PLOT W2,Y2
- I: PLOT W3,Y3 - I: PLOT W4,Y4 - I
2220 NEXT I
2230 X1 = 30:Z1 = 6:Z2 = 11:Z3 = 16:Z4 = 21
2240 FOR I = 0 TO 9
2250 PLOT X1 - I,Z1 + I: PLOT X1 - I,Z2 + I: PLOT X1 - I,Z3 + I: PLOT X1 - I,Z4
+ I
2260 PLOT X1 + I,Z1 + I: PLOT X1 + I,Z2 + I: PLOT X1 + I,Z3 + I: PLOT X1 + I,Z4
+ I
2270 PLOT X2 + I,Y2 + I: PLOT X3 + I,Y3 + I: PLOT X4 + I,Y4 + I
2280 PLOT W2 - I,Y2 + I: PLOT W3 - I,Y3 + I: PLOT W4 - I,Y4 + I
2290 NEXT I
2300 PRINT " UP(TOP) BACK LEFT"
2310 PRINT " FRONT RIGHT DOWN(BOTTOM)"
2320 X1 = 8:X2 = 7:Y1 = 37:Y2 = 36
2330 FOR J = 2 TO 4: FOR K = 2 TO 4
2340 I = 1
2350 GOSUB 2990
2360 FOR I = 0 TO 3
2370 PLOT X1 - 3 * (J - 2),Y1 - I - 5 * (K - 2) - 3 * (J - 2)
2380 PLOT X2 - 3 * (J - 2),Y2 - I - 5 * (K - 2) - 3 * (J - 2)
2390 NEXT I
2400 NEXT K: NEXT J
2410 X1 = 10:X2 = 11:Y1 = 37:Y2 = 36
2420 FOR I = 2 TO 4: FOR K = 2 TO 4
2430 J = 1
2440 GOSUB 2990
2450 FOR J = 0 TO 3
2460 PLOT X1 + 3 * (I - 2),Y1 - J - 5 * (K - 2) - 3 * (I - 2)
2470 PLOT X2 + 3 * (I - 2),Y2 - J - 5 * (K - 2) - 3 * (I - 2)
2480 NEXT J
2490 NEXT K: NEXT I
2500 X1 = 32:X2 = 31:Y1 = 22:Y2 = 21
2510 FOR I = 4 TO 2 STEP - 1: FOR K = 2 TO 4
2520 J = 5
2530 GOSUB 2990
2540 FOR J = 0 TO 3
2550 PLOT X1 + 3 * (4 - I),Y1 - J - 5 * (K - 2) + 3 * (4 - I)
2560 PLOT X2 + 3 * (4 - I),Y2 - J - 5 * (K - 2) + 3 * (4 - I)
2570 NEXT J
2580 NEXT K: NEXT I
2590 X1 = 28:X2 = 29:Y1 = 22:Y2 = 21
2600 FOR J = 4 TO 2 STEP - 1: FOR K = 2 TO 4
2610 I = 5
2620 GOSUB 2990
2630 FOR I = 0 TO 3
2640 PLOT X1 - 3 * (4 - J),Y1 - I - 5 * (K - 2) + 3 * (4 - J)
2650 PLOT X2 - 3 * (4 - J),Y2 - I - 5 * (K - 2) + 3 * (4 - J)
2660 NEXT I
2670 NEXT K: NEXT J
2680 X1 = 7:X2 = 8:X3 = 9:X4 = 10:X5 = 11
2690 Y1 = 21:Y2 = 22:Y3 = 23:Y4 = 22:Y5 = 21
2700 FOR I = 2 TO 4: FOR J = 2 TO 4
2710 K = 5
2720 GOSUB 2990
2730 PLOT X1 + 3 * (I - 2) - 3 * (J - 2),Y1 - 3 * (J - 2) - 3 * (I - 2)
2740 PLOT X5 + 3 * (I - 2) - 3 * (J - 2),Y5 - 3 * (J - 2) - 3 * (I - 2)
2750 FOR K = 0 TO 2
2760 PLOT X2 + 3 * (I - 2) - 3 * (J - 2),Y2 - K - 3 * (J - 2) - 3 * (I - 2)
2770 PLOT X4 + 3 * (I - 2) - 3 * (J - 2),Y4 - K - 3 * (J - 2) - 3 * (I - 2)
2780 NEXT K
2790 FOR K = 0 TO 4
2800 PLOT X3 + 3 * (I - 2) - 3 * (J - 2),Y3 - K - 3 * (J - 2) - 3 * (I - 2)
2810 NEXT K
2820 NEXT J: NEXT I
2830 X1 = 28:X2 = 29:X3 = 30:X4 = 31:X5 = 32
2840 Y1 = 24:Y2 = 23:Y3 = 22:Y4 = 23:Y5 = 24
2850 FOR I = 4 TO 2 STEP - 1: FOR J = 4 TO 2 STEP - 1
2860 K = 1
2870 GOSUB 2990
2880 PLOT X1 + 3 * (4 - I) - 3 * (4 - J),Y1 + 3 * (4 - J) + 3 * (4 - I)
2890 PLOT X5 + 3 * (4 - I) - 3 * (4 - J),Y5 + 3 * (4 - J) + 3 * (4 - I)
2900 FOR K = 0 TO 2
2910 PLOT X2 + 3 * (4 - I) - 3 * (4 - J),Y2 + K + 3 * (4 - J) + 3 * (4 - I)
2920 PLOT X4 + 3 * (4 - I) - 3 * (4 - J),Y4 + K + 3 * (4 - J) + 3 * (4 - I)
2930 NEXT K
2940 FOR K = 0 TO 4
2950 PLOT X3 + 3 * (4 - I) - 3 * (4 - J),Y3 + K + 3 * (4 - J) + 3 * (4 - I)
2960 NEXT K
2970 NEXT J: NEXT I
2980 RETURN
2990 IF R(I,J,K) < > 1 THEN 3010
3000 COLOR = 1: RETURN
3010 IF R(I,J,K) < > 15 THEN 3030
3020 COLOR = 15: RETURN
3030 IF R(I,J,K) < > 4 THEN 3050
3040 COLOR = 4: RETURN
3050 IF R(I,J,K) < > 9 THEN 3070
3060 COLOR = 9: RETURN
3070 IF R(I,J,K) < > 2 THEN 3090
3080 COLOR = 2: RETURN
3090 COLOR = 13: RETURN
3100 PRINT "THANK YOU FOR PLAYING."
3110 END

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First Aid For Cuber's Thumb

By Paul A. Turvill



Photo 1. The pristine Rubik's Cube.

Rubik's Cube—also known as the Magic Cube, and a number of less complimentary names by numerous harried puzzle fans—is the current intellectual puzzle rage. The puzzle is especially intriguing to mathematics, engineering and science buffs, for a number of reasons. Mechanically, it does things that at first glance would seem impossible, even to many experienced mechanical engineers. Mathematically, it is fascinating, having the ability to be arranged and rearranged into $2^{27} \times 3^{14} \times 5^3 \times 7^2 \times 11$ configurations—more than 4.3×10^{19} permutations!

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Cube solvers around the world—known as *cubists*—have become so enthralled with Rubik's Cube that it now occupies much of the spare time of literally millions of Earth's citizens. So popular and so intriguing is it that it has received attention on page one of *The Wall Street Journal* and the front cover of *Scientific American*.

Douglas Hofstadter's *Scientific American* article (March 1981, p. 20) is probably one of the best summaries of the cube's possibilities yet published. Hofstadter goes into mechanical construction, mathematical considerations and various approaches to developing solution algorithms. He also discusses in some detail a standard system of notation designed to permit cubists to readily exchange information about their solution efforts.

While Hofstadter's article is highly recommended, the following description should give a basic understanding of the device and point out the usefulness of the listed computer programs. Notation and terminology are based on those introduced by Hofstadter.

A Cube in the Hand

Rubik's Cube rests nicely on the palm of the hand. Each of its six faces is subdivided into nine equal *facelets*. In the starting position, or *pristine state*, each of the cube's major faces is a different uniform color (see Photo 1).

The cube is cut between facelets—in fact, it consists of 26 visible *cubies* (the centermost space is assumed to

be unoccupied). Further, the 26 cubies are interlocked so that the nine cubies that make up each of the six major faces may be rotated as a group (see Photo 2).

By rotating any one face, you can partially rearrange the four adjacent faces. Thus, a series of 90-degree rotations of the various faces can quickly *scramble* the arrangement of the colored facelets.

Most cubists have had great difficulty establishing even a few common predetermined patterns, not to mention returning their cubes to the pristine state. A number of algorithms have been developed with varying degrees of success.

The Programs

These computer programs—one in BASIC (Listing 1), and one in Z-80 assembly language (Listing 2)—are intended to help you make sequences of moves to take the cube from one state to another. The programs oper-

Face	Rotation	
	CW	CCW
Up (top)	U	u
Down (bottom)	D	d
Left side	L	l
Right side	R	r
Front	F	f
Back	B	b

Table 1.

ate essentially identically, although it will be seen that the machine-language code generated by the assembly-language program is far more efficient in memory requirements and operating speed. Because of their similarity, the following discussion applies equally to both.

The notation used (based on the Hofstadter article) is as follows: the major faces are identified in accordance with their positions on a cube held stationary in relation to the viewer—Up, Down, Left, Right, Front and Back (see Fig. 1).

For simplicity and ease of presentation on a two-dimensional alphanumeric display device (and printer), the cube is *unfolded* so that its six faces can be seen simultaneously (see Fig. 2).

Once the program is loaded and running properly, the legend Move Sequence: will appear at the top of the screen, with a representation of the unfolded cube laid out below, in its pristine state (see Sample run in Fig. 3). Thereafter, keying any of the 12 legal move commands will cause the appropriate face to be rotated by 90 degrees, and the four adjacent faces to be rearranged accordingly. The Move Sequence will be updated and the display modified to reflect the cumulative effect of all move commands.

Table 1 summarizes the 12 permissible move commands and their effects; in the table, CW indicates clockwise, or "right" rotation, and CCW means counterclockwise, or "left." The notation differs somewhat from that of the Hofstadter article. To retain the simplicity afforded by single character commands, these programs use a combination of up-

percase (for CW) and lowercase (CCW) characters.

In addition to the 12 move commands, three additional commands are available:

●P (Print) produces a hard copy of the current screen.

●N (New) reinitializes the cube to the pristine state or starting position.

●X(e)it returns control to the system monitor (or the interpreter in the case of BASIC).

Languages

Some comments are in order regarding programming languages and formats. Many differences exist among the various forms of BASIC. Cube is written to run in a modified form of Digital Group Business BASIC 1.0, which contains a number of shortcuts (the option to use # for PRINT, for example), and has its own approach to the handling of string variables. It should not be too difficult for the moderately capable reader to make the necessary conversions to nearly any other form of BASIC having string capabilities. Explanatory REM statements are included in the BASIC program where they may be useful.

Programs written for assembly lan-



Photo 2. Rubik's Cube with one face partly rotated.

guages, while usually considered more difficult to write and debug, are generally more universal since the machine-language codes they produce can normally be made to run on just about any machine based on the same or similar microprocessor technology. That is, any assembly program written for one Z-80 machine can generally be made to run on another Z-80 system, provided the I/O port assignments and peripheral driver routines are made compatible.

Further, machine code is usually highly efficient as compared to the

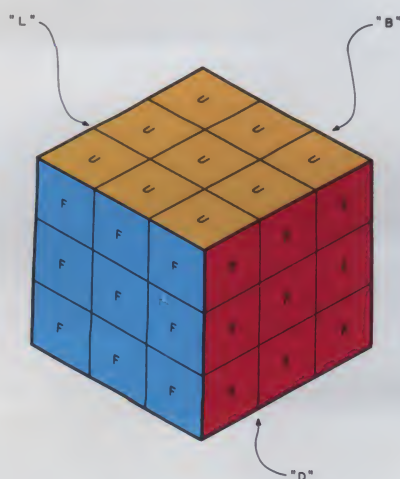


Fig. 1. Face-identification symbols.

Listing 1. The BASIC listing of the Cube program.

```

1000 REM *****
1010 REM * RUBIK'S CUBE PUZZLE SIMULATOR PROGRAM *
1020 REM * BASIC VERSION 1.00 BY PAUL A. TURVILL *
1030 REM ***** MARCH, 1981 *****
1040 REM *****
1050 REM *
1060 REM * INITIALIZE VARIABLES
1070 REM *
1080 DIM U$(9),D$(9),L$(9),R$(9),F$(9),B$(9)
1090 DIM X$(9),Y$(9),Q$(113),A$(1)
1100 Q$=" " : N=0
1110 FOR I=1 TO 9
1120   U$=U$+"U" : D$=D$+"D"
1130   L$=L$+"L" : R$=R$+"R"
1140   F$=F$+"F" : B$=B$+"B"
1150   Q$=Q$+Q$
1160 NEXT I
1170 REM *
1180 REM * DISPLAY INITIAL SCREEN - NOTE THAT THE SYMBOL "#"
1190 REM * IS USED THROUGHOUT THIS PROGRAM TO REPRESENT THE
1200 REM * "PRINT" STATEMENT.
1210 REM *
1220 GOSUB 1500
1230 REM *
1240 REM * OUTPUT CURSOR CHARACTER
1250 REM *
1260 #CHR$(8);CHR$(95);CHR$(8);
1270 REM *
1280 REM * GET COMMAND AND DECODE IT
1290 REM *
1300 KEYIN A$ : #A$;
1310 IF A$="U" THEN GOSUB 2030
1320 IF A$="u" THEN GOSUB 2110
1330 IF A$="D" THEN GOSUB 2190
1340 IF A$="d" THEN GOSUB 2260
1350 IF A$="L" THEN GOSUB 2330
1360 IF A$="l" THEN GOSUB 2440
1370 IF A$="R" THEN GOSUB 2550

```

More

"BASIC program plus interpreter" required to perform the same duties.

Table 2 compares the two versions of Cube. Readers interested in such things might wish to develop versions of both to verify or refute the comparisons contained in the table.

The computer simulation has a number of advantages over the actual Rubik's Cube, especially for beginning cubists. Unscrambling a randomly scrambled cube can take from a couple of hours to several weeks; on the computer, instant recovery requires only the entry of an N command.

Moving from one structured pattern to another often requires surprisingly few moves, although discovering the exact combination of moves required may involve a great many trial-and-error iterations and numerous dead ends. Once a desired configuration is achieved on the video terminal, entering a P command will print not only the current configuration, but a record of up to the last 113 moves. (In the event the computer-wielding cubist makes 113 moves without achieving a desired result, the computer takes over and

Listing 1 continued.

```

1380 IF A$="r" THEN GOSUB 2660
1390 IF A$="F" THEN GOSUB 2770
1400 IF A$="f" THEN GOSUB 2870
1410 IF A$="B" THEN GOSUB 2970
1420 IF A$="b" THEN GOSUB 3070
1430 IF A$="N" THEN #""; : RUN
1440 IF A$="X" THEN #""; : END
1450 IF A$="P" THEN GOSUB 3340
1460 GOTO 1260
1470 REM *
1480 REM * SCREEN/PRINTER FORMATTING ROUTINE
1490 REM *
1500 CURSOR 0 : # "Move Sequence: ";Q$;
1510 IF A$="p" THEN #""
1520 FOR I=1 TO 9
1530 IF (I=1 OR I=4 OR I=7) THEN #"" : #TAB(23);
1540 #U$(I,I);" ";
1550 NEXT I
1560 #"" : #""
1570 FOR I=0 TO 2
1580 #TAB(12);
1590 FOR J=1 TO 3 : K=3*I+J
1600 #L$(K,K);" ";
1610 NEXT J
1620 #"";
1630 FOR J=1 TO 3 : K=3*I+J
1640 #F$(K,K);" ";
1650 NEXT J
1660 #"";
1670 FOR J=1 TO 3 : K=3*I+J
1680 #R$(K,K);" ";
1690 NEXT J
1700 #"";
1710 FOR J=1 TO 3 : K=3*I+J
1720 #B$(K,K);" ";
1730 NEXT J
1740 #"" : NEXT I
1750 FOR I=1 TO 9
1760 IF (I=1 OR I=4 OR I=7) THEN #"" : #TAB(23);
1770 #D$(I,I);" ";
1780 NEXT I
1790 #"" : #"" : # "Next Move: ";
1800 IF N=113 THEN N=0 : A$="P"
1810 RETURN
1820 REM *
1830 REM * STRING HANDLING ROUTINES - EACH FACE OF CUBE IS
1840 REM * REPRESENTED BY A STRING VARIABLE, NINE CHARACTERS
1850 REM * IN LENGTH. TOP ROW OF FACE AS DISPLAYED ON SCREEN
1860 REM * IS REPRESENTED BY POSITIONS 1, 2, AND 3; MIDDLE
1870 REM * ROW BY 4, 5, AND 6; AND BOTTOM ROW BY 7, 8, AND 9.
1880 REM * PARTIAL STRINGS ARE DEPICTED BY THE VARIABLE NAME
1890 REM * FOLLOWED BY THE STARTING AND ENDING POSITIONS IN
1900 REM * PARENTHESES [EXAMPLE: BOTTOM ROW, FRONT FACE IS
1910 REM * F$(7,9)]. IF ONLY ONE POSITION IS GIVEN IN PAREN-
1920 REM * THESES, IT IS ASSUMED THAT ALL CHARACTERS FROM
1930 REM * NUMBERED POSITION TO THE END ARE INTENDED [EXAMPLE:
1940 REM * U$(4) IS EQUIVALENT TO U$(4,9)]. IN ANY STRING
1950 REM * TRANSACTION THE NUMBER OF CHARACTERS ALTERED IS
1960 REM * GOVERNED BY THE SHORTER SUBSTRING [EXAMPLE: THE
1970 REM * STATEMENT "F$(1)=L$(1,3)" WILL CAUSE THE FIRST
1980 REM * THREE CHARACTERS OF F$ TO BE SET TO THE FIRST THREE
1990 REM * CHARACTERS OF L$].
2000 REM *
2010 REM * UP FACE, CLOCKWISE (CW) ROTATION
2020 REM *
2030 X$=U$ : GOSUB 3140 : U$=Y$
2040 X$=L$
2050 L$(1)=F$(1,3) : F$(1)=R$(1,3)
2060 R$(1)=B$(1,3) : B$(1)=X$(1,3)
2070 GOTO 1500
2080 REM *
2090 REM * UP FACE, COUNTERCLOCKWISE (CCW) ROTATION
2100 REM *
2110 X$=U$ : GOSUB 3190 : U$=Y$
2120 X$=L$
2130 L$(1)=B$(1,3) : B$(1)=R$(1,3)
2140 R$(1)=F$(1,3) : F$(1)=X$(1,3)
2150 GOTO 1500
2160 REM *
2170 REM * DOWN FACE, CW
2180 REM *
2190 X$=D$ : GOSUB 3140 : D$=Y$

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automatically prints a hard copy, before starting to overwrite the previous Move Sequence.)

The printed record of moves made can then be manually edited for redundancy (U1 followed immediately by Lu, for example), and the resultant

edited sequence quickly verified in another run.

Working with both computer and cube, the cubist can systematically apply real moves to the cube after perfecting each sequence painlessly on the machine.

A couple of fairly simple sequences exist that clearly illustrate the cube's possibilities. First try UdR1FbUd; then uuddllrrffbb (or UUDDLLRRF-FBB); then combine these and others. Vast numbers of other combinations will suggest themselves, but exercise

(continued on page 46)

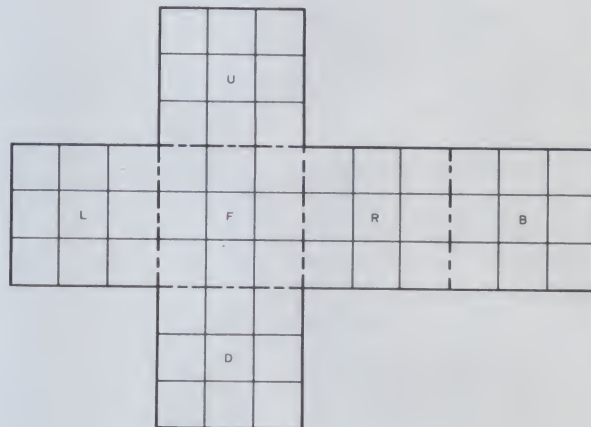
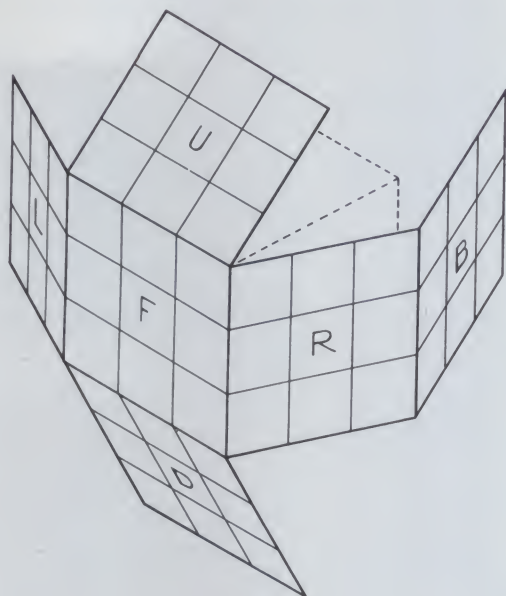


Fig. 2. Unfolding the cube for the video display.

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Listing 1 continued.

```

2200 X$=L$(7)
2210 L$(7)=B$(7) : B$(7)=R$(7) : R$(7)=F$(7) : F$(7)=X$
2220 GOTO 1500
2230 REM *
2240 REM * DOWN FACE, CCW
2250 REM *
2260 X$=D$ : GOSUB 3190 : D$=Y$
2270 X$=L$(7)
2280 L$(7)=F$(7) : F$(7)=R$(7) : R$(7)=B$(7) : B$(7)=X$
2290 GOTO 1500
2300 REM *
2310 REM * LEFT FACE, CW
2320 REM *
2330 X$=L$ : GOSUB 3140 : L$=Y$
2340 X$=U$
2350 U$(1)=B$(9) : U$(4)=B$(6,6) : U$(7)=B$(3,3)
2360 B$(3)=D$(7,7) : B$(6)=D$(4,4) : B$(9)=D$(1)
2370 FOR I=1 TO 7 STEP 3
2380 D$(I)=F$(I,I) : F$(I)=X$(I,I)
2390 NEXT I
2400 GOTO 1500
2410 REM *

```

More

Move Sequence:

```

U U U
U U U
U U U

```

```

L L L F F F R R R B B B
L L L F F F R R R B B B
L L L F F F R R R B B B

```

```

D D D
D D D
D D D

```

Next Move:

Move Sequence: UdRlFbUd

```

F F F
F U F
F F F

```

```

D D D R R R U U U L L L
D L D R F R U R U L B L
D D D R R R U U U L L L

```

```

B B B
B D B
B B B

```

Next Move:

Move Sequence: UdRlFbUduuddllrrffbb

```

F B F
B U B
F B F

```

```

D U D R L R U D U L R L
U L U L F L D R D R B R
D U D R L R U D U L R L

```

```

B F B
F D F
B F B

```

Next Move:

Fig. 3. The cube, as it appears on the video display, in its original state and as it appears after two Move Sequences.

Listing 1 continued.

```

2420 REM * LEFT FACE, CCW
2430 REM *
2440 X$=L$: GOSUB 3190 : L$=Y$
2450 X$=U$
2460 FOR I=1 TO 7 STEP 3
2470   U$(I)=F$(I,I) : F$(I)=D$(I,I)
2480   NEXT I
2490 D$(1)=B$(9) : D$(4)=B$(6,6) : D$(7)=B$(3,3)
2500 B$(3)=X$(7,7) : B$(6)=X$(4,4) : B$(9)=X$(1)
2510 GOTO 1500
2520 REM *
2530 REM * RIGHT FACE, CW
2540 REM *
2550 X$=R$: GOSUB 3140 : R$=Y$
2560 X$=U$
2570 FOR I=3 TO 9 STEP 3
2580   U$(I)=F$(I,I) : F$(I)=D$(I,I)
2590   NEXT I
2600 D$(3)=B$(7,7) : D$(6)=B$(4,4) : D$(9)=B$(1)
2610 B$(1)=X$(9) : B$(4)=X$(6,6) : B$(7)=X$(3,3)
2620 GOTO 1500
2630 REM *
2640 REM * RIGHT FACE, CCW
2650 REM *
2660 X$=R$: GOSUB 3190 : R$=Y$
2670 X$=U$
2680 U$(3)=B$(7,7) : U$(6)=B$(4,4) : U$(9)=B$(1)
2690 B$(1)=D$(9) : B$(4)=D$(6,6) : B$(7)=D$(3,3)
2700 FOR I=3 TO 9 STEP 3
2710   D$(I)=F$(I,I) : F$(I)=X$(I,I)
2720   NEXT I
2730 GOTO 1500
2740 REM *
2750 REM * FRONT FACE, CW
2760 REM *
2770 X$=F$: GOSUB 3140 : F$=Y$
2780 X$=U$
2790 U$(7)=L$(9) : U$(8)=L$(6) : U$(9)=L$(3)
2800 L$(3)=D$(1,1) : L$(6)=D$(2,2) : L$(9)=D$(3)
2810 D$(1)=R$(7) : D$(2)=R$(4,4) : D$(3)=R$(1,1)
2820 R$(1)=X$(7,7) : R$(4)=X$(8,8) : R$(7)=X$(9)
2830 GOTO 1500
2840 REM *
2850 REM * FRONT FACE, CCW
2860 REM *
2870 X$=F$: GOSUB 3190 : F$=Y$
2880 X$=U$
2890 U$(7)=R$(1) : U$(8)=R$(4) : U$(9)=R$(7)
2900 R$(1)=D$(3,3) : R$(4)=D$(2,2) : R$(7)=D$(1,1)
2910 D$(1)=L$(3,3) : D$(2)=L$(6,6) : D$(3)=L$(9)
2920 L$(3)=X$(9) : L$(6)=X$(8,8) : L$(9)=X$(7)
2930 GOTO 1500
2940 REM *
2950 REM * BACK FACE, CW
2960 REM *
2970 X$=B$: GOSUB 3140 : B$=Y$
2980 X$=U$
2990 U$(1)=R$(3,3) : U$(2)=R$(6,6) : U$(3)=R$(9)
3000 R$(3)=D$(9) : R$(6)=D$(8,8) : R$(9)=D$(7)
3010 D$(7)=L$(1) : D$(8)=L$(4) : D$(9)=L$(7)
3020 L$(1)=X$(3,3) : L$(4)=X$(2,2) : L$(7)=X$(3,3)
3030 GOTO 1500
3040 REM *
3050 REM * BACK FACE, CCW
3060 REM *
3070 X$=B$: GOSUB 3190 : B$=Y$
3080 X$=U$
3090 U$(1)=L$(7) : U$(2)=L$(4,4) : U$(3)=L$(1,1)
3100 L$(1)=D$(7,7) : L$(4)=D$(8,8) : L$(7)=D$(9)
3110 D$(7)=R$(9) : D$(8)=R$(6) : D$(9)=R$(3)
3120 R$(3)=X$(1,1) : R$(6)=X$(2,2) : R$(9)=X$(3)
3130 GOTO 1500
3140 GOSUB 3240
3150 Y$(1)=X$(7) : Y$(2)=X$(4,4) : Y$(3)=X$(1,1)
3160 Y$(4)=X$(8,8) : Y$(6)=X$(2)
3170 Y$(7)=X$(9) : Y$(8)=X$(6) : Y$(9)=X$(3)
3180 RETURN
3190 GOSUB 3240
3200 Y$(1)=X$(3,3) : Y$(2)=X$(6,6) : Y$(3)=X$(9)
3210 Y$(4)=X$(2,2) : Y$(6)=X$(8)
3220 Y$(7)=X$(1) : Y$(8)=X$(4) : Y$(9)=X$(7)
3230 RETURN
3240 Y$=X$ : N=N+1 : Q$(N)=A$

```

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Listing 1 continued.

```

3250 IF N,113 THEN Q$(N+1)=" "
3260 RETURN
3270 REM *
3280 REM * HARDCOPY ROUTINE - "FILL" STATEMENT IS EQUIVALENT
3290 REM * TO "POKE," AND IS USED HERE TO TEMPORARILY ADJUST
3300 REM * OUTPUT LINE LENGTH TO PREVENT PRINTER FROM OVER-
3310 REM * RUNNING PAPER WIDTH. "OPEN" AND "CLOSE" STATEMENTS
3320 REM * TURN OUTPUT DEVICES ON AND OFF.
3330 REM *
3340 CLOSE (CRT,E) : OPEN (PRINTER,E)
3350 FILL 12890,64 : A$="p"
3360 #""
3370 GOSUB 1500
3380 FOR I=1 TO 12 : #"" : NEXT I
3390 CLOSE (PRINTER,E) : OPEN (CRT,E)
3400 FILL 12890,132 : A$=" "
3410 GOTO 1500

```

	Bytes of Code	Assembly
Interpreter	17,920	0 (1)
Main Program	5,507	2,224
Variables	329	0 (2)
Printer Driver	0 (3)	768
Total Bytes	23,756	2,992
Each Command	2.0 sec.	0.1 sec.
20 Commands (4)	44.0 sec.	5.4 sec.

Notes:

- (1) Assembly-language program need not be present while application program is running.
- (2) Variable storage locations included in main program.
- (3) Printer driver included in BASIC interpreter.
- (4) Includes operator reaction times between keystrokes.

Table 2. Comparison of features of the BASIC and assembly versions of the Cube program.

Listing 2. Z-80 assembly-language version of the Cube program.

```

0000 0100 ST 0
0000 0110 *
0000 0120 *****
0000 0130 * RUBIK'S CUBE PUZZLE SIMULATOR PROGRAM *
0000 0140 * VERSION 1.00 BY PAUL A. TURVILL *
0000 0150 ***** MARCH, 1981 *****
0000 0160 *****
0000 0170 *
0000 18 15 0180 START JR BEGIN
0002 C3 18 01 0190 JP UPDATE RESTART VECTORS
0005 C3 88 E3 0200 JP EDITOR
0008 C3 6A E3 0210 JP KEYIN
000B C3 70 F3 0220 JP TRMOUT
000E C3 8A 08 0230 JP PRINT
0011 C3 B0 EF 0240 JP LPRTR
0014 C3 00 00 0250 JP 0
0017 31 8A 08 0260 BEGIN LD SP,STAK SET STACK POINTER
001A 11 7F 07 0270 LD DE,MOVES INITIALIZE
001D 0E 71 0280 LD C,113D MOVE
001F D5 0290 PUSH DE SEQUENCE
0020 EB 0300 EX DE,HL RECORD
0021 41 0310 LD B,C
0022 36 A0 0320 BEGIN1 LD M,240
0024 23 0330 INC HL
0025 10 FB 0340 DJNZ BEGIN1
0027 D1 0350 POP DE
0028 3E D5 0360 INIT LD A,'U' INITIALIZE
002A 32 F2 07 0370 LD (U1),A CUBE
002D 32 F4 07 0380 LD (U2),A TO
0030 32 F6 07 0390 LD (U3),A STARTING
0033 32 F8 07 0400 LD (U4),A POSITION
0036 32 FC 07 0410 LD (U6),A

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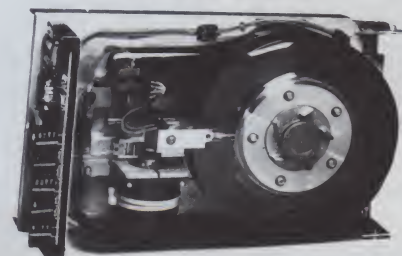
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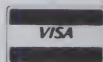
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0039 32 FE 07	0420	LD	(U7),A
003C 32 00 08	0430	LD	(U8),A
003F 32 02 08	0440	LD	(U9),A
0042 3E C4	0450	LD	A,'D'
0044 32 4C 08	0460	LD	(D1),A
0047 32 4E 08	0470	LD	(D2),A
004A 32 50 08	0480	LD	(D3),A
004D 32 52 08	0490	LD	(D4),A
0050 32 56 08	0500	LD	(D6),A
0053 32 58 08	0510	LD	(D7),A
0056 32 5A 08	0520	LD	(D8),A
0059 32 5C 08	0530	LD	(D9),A
005C 3E CC	0540	LD	A,'L'
005E 32 04 08	0550	LD	(L1),A
0061 32 06 08	0560	LD	(L2),A
0064 32 08 08	0570	LD	(L3),A
0067 32 1C 08	0580	LD	(L4),A
006A 32 20 08	0590	LD	(L6),A
006D 32 34 08	0600	LD	(L7),A
0070 32 36 08	0610	LD	(L8),A
0073 32 38 08	0620	LD	(L9),A
0076 3E D2	0630	LD	A,'R'
0078 32 10 08	0640	LD	(R1),A
007B 32 12 08	0650	LD	(R2),A
007E 32 14 08	0660	LD	(R3),A
0081 32 28 08	0670	LD	(R4),A
0084 32 2C 08	0680	LD	(R6),A
0087 32 40 08	0690	LD	(R7),A
008A 32 42 08	0700	LD	(R8),A
008D 32 44 08	0710	LD	(R9),A
0090 3E C6	0720	LD	A,'F'
0092 32 0A 08	0730	LD	(F1),A
0095 32 0C 08	0740	LD	(F2),A
0098 32 0E 08	0750	LD	(F3),A
009B 32 22 08	0760	LD	(F4),A
009E 32 26 08	0770	LD	(F6),A
00A1 32 3A 08	0780	LD	(F7),A
00A4 32 3C 08	0790	LD	(F8),A
00A7 32 3E 08	0800	LD	(F9),A
00AA 3E C2	0810	LD	A,'B'
00AC 32 16 08	0820	LD	(B1),A
00AF 32 18 08	0830	LD	(B2),A
00B2 32 1A 08	0840	LD	(B3),A
00B5 32 2E 08	0850	LD	(B4),A
00B8 32 32 08	0860	LD	(B6),A
00BB 32 46 08	0870	LD	(B7),A
00BE 32 48 08	0880	LD	(B8),A
00C1 32 4A 08	0890	LD	(B9),A
00C4	0900 *		
00C4	0910 *	SCREEN DISPLAY ROUTINE	
00C4	0920 *		
00C4 21 6F 07	0930	DISPLY LD	HL,SCREEN
00C7 C5	0940		PUSH BC
00C8 D7	0950		RST 20
00C9 C1	0960		POP BC
00CA	0970 *		
00CA	0980 *	COMMAND INPUT AND RECOGNITION	
00CA	0990 *		
00CA DF	1000	GETCMD RST	30
00CB E7	1010		RST 40
00CC FE D5	1020		CP 'U'
00CE 28 57	1030		JR Z,UPRT
00D0 FE F5	1040		CP 'u'
00D2 CA AD 01	1050		JP Z,UPLT
00D5 FE C4	1060		CP 'D'
00D7 CA 33 02	1070		JP Z,DNRT
00DA FE E4	1080		CP 'd'
00DC CA B9 02	1090		JP Z,DNLT
00DF FE CC	1100		CP 'L'
00E1 CA 3F 03	1110		JP Z,LTRT
00E4 FE EC	1120		CP 'l'
00E6 CA C5 03	1130		JP Z,LTLT
00E9 FE D2	1140		CP 'R'
00EB CA 4B 04	1150		JP Z,RTRT
00EE FE F2	1160		CP 'r'
00F0 CA D1 04	1170		JP Z,RTLT
00F3 FE C6	1180		CP 'F'
00F5 CA 57 05	1190		JP Z,FRRT
00F8 FE E6	1200		CP 'f'
00FA CA DD 05	1210		JP Z,FRLT
00FD FE C2	1220		CP 'B'
00FF CA 63 06	1230		JP Z,BKRT
0102 FE E2	1240		CP 'b'
0104 CA E9 06	1250		JP Z,BKLT

More

Listing 2 continued.

0107 FE CE	1260	CP	'N'
0109 CA 17 00	1270	JP	Z,BEGIN
010C FE D8	1280	CP	'X'
010E CA 00 E0	1290	JP	Z,MONITR
0111 FE D0	1300	CP	'P'
0113 CC 8A 08	1310	CALL	Z,PRINT
0116 18 AC	1320	JR	DISPLY
0118	1330 *		
0118	1340 *	"UPDATE"	KEEPS TRACK OF MOVES MADE
0118	1350 *		
0118 12	1360	UPDATE LD	(DE),A
0119 13	1370	INC	DE
011A 3E A0	1380	LD	A,240
011C 12	1390	LD	(DE),A
011D 0D	1400	DEC	C
011E C0	1410	RET	NZ
011F 11 7F 07	1420	LD	DE,MOVES
0122 OE 71	1430	LD	C,113D
0124 EF	1440	RST	50
0125 18 9D	1450	JR	DISPLY
0127	1460 *		
0127	1470 *	U = UP SURFACE,	CLOCKWISE ROTATION
0127	1480 *		
0127 CF	1490	UPRT	RST 10
0128 3A F2 07	1500	LD	A,(U1)
012B 47	1510	LD	B,A
012C 3A FE 07	1520	LD	A,(U7)
012F 32 F2 07	1530	LD	(U1),A
0132 3A 02 08	1540	LD	A,(U9)
0135 32 FE 07	1550	LD	(U7),A
0138 3A F6 07	1560	LD	A,(U3)
013B 32 02 08	1570	LD	(U9),A
013E 78	1580	LD	A,B
013F 32 F6 07	1590	LD	(U3),A
0142 3A F4 07	1600	LD	A,(U2)
0145 47	1610	LD	B,A
0146 3A F8 07	1620	LD	A,(U4)
0149 32 F4 07	1630	LD	(U2),A
014C 3A 00 08	1640	LD	A,(U8)
014F 32 F8 07	1650	LD	(U4),A
0152 3A FC 07	1660	LD	A,(U6)
0155 32 00 08	1670	LD	(U8),A
0158 78	1680	LD	A,B
0159 32 FC 07	1690	LD	(U6),A
015C 3A 04 08	1700	LD	A,(L1)
015F 47	1710	LD	B,A
0160 3A 0A 08	1720	LD	A,(F1)
0163 32 04 08	1730	LD	(L1),A
0166 3A 10 08	1740	LD	A,(R1)
0169 32 0A 08	1750	LD	(F1),A
016C 3A 16 08	1760	LD	A,(B1)
016F 32 10 08	1770	LD	(R1),A
0172 78	1780	LD	A,B
0173 32 16 08	1790	LD	(B1),A
0176 3A 06 08	1800	LD	A,(L2)
0179 47	1810	LD	B,A
017A 3A 0C 08	1820	LD	A,(F2)
017D 32 06 08	1830	LD	(L2),A
0180 3A 12 08	1840	LD	A,(R2)
0183 32 0C 08	1850	LD	(F2),A
0186 3A 18 08	1860	LD	A,(B2)
0189 32 12 08	1870	LD	(R2),A
018C 78	1880	LD	A,B
018D 32 18 08	1890	LD	(B2),A
0190 3A 08 08	1900	LD	A,(L3)
0193 47	1910	LD	B,A
0194 3A 0E 08	1920	LD	A,(F3)
0197 32 08 08	1930	LD	(L3),A
019A 3A 14 08	1940	LD	A,(R3)
019D 32 0E 08	1950	LD	(F3),A
01A0 3A 1A 08	1960	LD	A,(B3)
01A3 32 14 08	1970	LD	(R3),A
01A6 78	1980	LD	A,B
01A7 32 1A 08	1990	LD	(B3),A
01AA C3 C4 00	2000	JP	DISPLY
01AD	2010 *		
01AD	2020 *	u = UP SURFACE,	COUNTERCLOCKWISE
01AD	2030 *		
01AD CF	2040	UPLT	RST 10
01AE 3A F2 07	2050	LD	A,(U1)
01B1 47	2060	LD	B,A
01B2 3A F6 07	2070	LD	A,(U3)
01B5 32 F2 07	2080	LD	(U1),A
01B8 3A 02 08	2090	LD	A,(U9)

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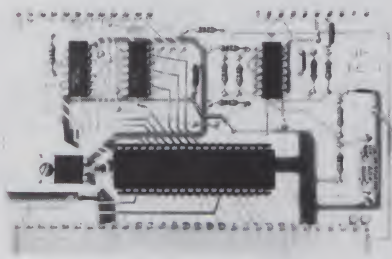
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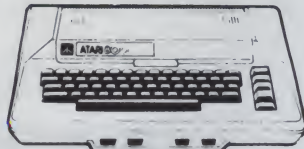
Listing 2 continued.

01BB 32 F6 07	2100	LD (U3), A
01BE 3A FE 07	2110	LD A, (U7)
01C1 32 02 08	2120	LD (U9), A
01C4 78	2130	LD A, B
01C5 32 FE 07	2140	LD (U7), A
01C8 3A F4 07	2150	LD A, (U2)
01CB 47	2160	LD B, A
01CC 3A FC 07	2170	LD A, (U6)
01CF 32 F4 07	2180	LD (U2), A
01D2 3A 00 08	2190	LD A, (U8)
01D5 32 FC 07	2200	LD (U6), A
01D8 3A F8 07	2210	LD A, (U4)
01DB 32 00 08	2220	LD (U8), A
01DE 78	2230	LD A, B
01DF 32 F8 07	2240	LD (U4), A
01E2 3A 04 08	2250	LD A, (L1)
01E5 47	2260	LD B, A
01E6 3A 16 08	2270	LD A, (B1)
01E9 32 04 08	2280	LD (L1), A
01EC 3A 10 08	2290	LD A, (R1)
01EF 32 16 08	2300	LD (B1), A
01F2 3A 0A 08	2310	LD A, (F1)
01F5 32 10 08	2320	LD (R1), A
01F8 78	2330	LD A, B
01F9 32 0A 08	2340	LD (F1), A
01FC 3A 06 08	2350	LD A, (L2)
01FF 47	2360	LD B, A
0200 3A 18 08	2370	LD A, (B2)
0203 32 06 08	2380	LD (L2), A
0206 3A 12 08	2390	LD A, (R2)
0209 32 18 08	2400	LD (B2), A
020C 3A 0C 08	2410	LD A, (F2)
020F 32 12 08	2420	LD (R2), A
0212 78	2430	LD A, B
0213 32 0C 08	2440	LD (F2), A
0216 3A 08 08	2450	LD A, (L3)
0219 47	2460	LD B, A
021A 3A 1A 08	2470	LD A, (B3)
021D 32 08 08	2480	LD (L3), A
0220 3A 14 08	2490	LD A, (R3)
0223 32 1A 08	2500	LD (B3), A
0226 3A 0E 08	2510	LD A, (F3)
0229 32 14 08	2520	LD (R3), A
022C 78	2530	LD A, B
022D 32 0E 08	2540	LD (F3), A
0230 C3 C4 00	2550	JP DISPLY
0233	2560 *	
0233	2570 * D = DOWN SURFACE, CLOCKWISE	
0233	2580 *	
0233 CF	2590 DNRT RST 10	
0234 3A 4C 08	2600	LD A, (D1)
0237 47	2610	LD B, A
0238 3A 58 08	2620	LD A, (D7)
023B 32 4C 08	2630	LD (D1), A
023E 3A 5C 08	2640	LD A, (D9)
0241 32 58 08	2650	LD (D7), A
0244 3A 50 08	2660	LD A, (D3)
0247 32 5C 08	2670	LD (D9), A
024A 78	2680	LD A, B
024B 32 50 08	2690	LD (D3), A
024E 3A 4E 08	2700	LD A, (D2)
0251 47	2710	LD B, A
0252 3A 52 08	2720	LD A, (D4)
0255 32 4E 08	2730	LD (D2), A
0258 3A 5A 08	2740	LD A, (D8)
025B 32 52 08	2750	LD (D4), A
025E 3A 56 08	2760	LD A, (D6)
0261 32 5A 08	2770	LD (D8), A
0264 78	2780	LD A, B
0265 32 56 08	2790	LD (D6), A
0268 3A 34 08	2800	LD A, (L7)
026B 47	2810	LD B, A
026C 3A 46 08	2820	LD A, (B7)
026F 32 34 08	2830	LD (L7), A
0272 3A 40 08	2840	LD A, (R7)
0275 32 46 08	2850	LD (B7), A
0278 3A 3A 08	2860	LD A, (F7)
027B 32 40 08	2870	LD (R7), A
027E 78	2880	LD A, B
027F 32 3A 08	2890	LD (F7), A
0282 3A 36 08	2900	LD A, (L8)
0285 47	2910	LD B, A
0286 3A 48 08	2920	LD A, (B8)
0289 32 36 08	2930	LD (L8), A

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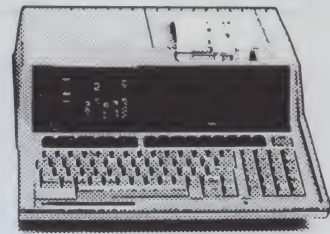
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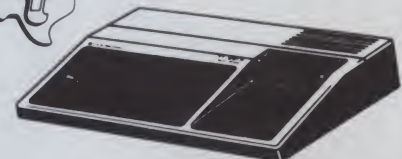
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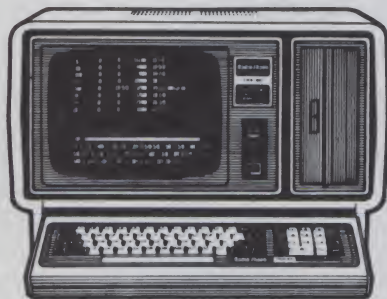
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Listing 2 continued.

028C 3A 42 08	2940	LD	A, (R8)
028F 32 48 08	2950	LD	(B8), A
0292 3A 3C 08	2960	LD	A, (F8)
0295 32 42 08	2970	LD	(R8), A
0298 78	2980	LD	A, B
0299 32 3C 08	2990	LD	(F8), A
029C 3A 38 08	3000	LD	A, (L9)
029F 47	3010	LD	B, A
02A0 3A 4A 08	3020	LD	A, (B9)
02A3 32 38 08	3030	LD	(L9), A
02A6 3A 44 08	3040	LD	A, (R9)
02A9 32 4A 08	3050	LD	(B9), A
02AC 3A 3E 08	3060	LD	A, (F9)
02AF 32 44 08	3070	LD	(R9), A
02B2 78	3080	LD	A, B
02B3 32 3E 08	3090	LD	(F9), A
02B6 C3 C4 00	3100	JP	DISPLY
02B9	3110	*	
02B9	3120	* d = DOWN SURFACE, COUNTERCLOCKWISE	
02B9	3130	*	
02B9 CF	3140	DNLT	RST 10
02BA 3A 4C 08	3150	LD	A, (D1)
02BD 47	3160	LD	B, A
02BE 3A 50 08	3170	LD	A, (D3)
02C1 32 4C 08	3180	LD	(D1), A
02C4 3A 5C 08	3190	LD	A, (D9)
02C7 32 50 08	3200	LD	(D3), A
02CA 3A 58 08	3210	LD	A, (D7)
02CD 32 5C 08	3220	LD	(D9), A
02D0 78	3230	LD	A, B
02D1 32 58 08	3240	LD	(D7), A
02D4 3A 4E 08	3250	LD	A, (D2)
02D7 47	3260	LD	B, A
02D8 3A 56 08	3270	LD	A, (D6)
02DB 32 4E 08	3280	LD	(D2), A
02DE 3A 5A 08	3290	LD	A, (D8)
02E1 32 56 08	3300	LD	(D6), A
02E4 3A 52 08	3310	LD	A, (D4)
02E7 32 5A 08	3320	LD	(D8), A
02EA 78	3330	LD	A, B
02EB 32 52 08	3340	LD	(D4), A
02EE 3A 34 08	3350	LD	A, (L7)
02F1 47	3360	LD	B, A
02F2 3A 3A 08	3370	LD	A, (F7)
02F5 32 34 08	3380	LD	(L7), A
02F8 3A 40 08	3390	LD	A, (R7)
02FB 32 3A 08	3400	LD	(F7), A
02FE 3A 46 08	3410	LD	A, (B7)
0301 32 40 08	3420	LD	(R7), A
0304 78	3430	LD	A, B
0305 32 46 08	3440	LD	(B7), A
0308 3A 36 08	3450	LD	A, (L8)
030B 47	3460	LD	B, A
030C 3A 3C 08	3470	LD	A, (F8)
030F 32 36 08	3480	LD	(L8), A
0312 3A 42 08	3490	LD	A, (R8)
0315 32 3C 08	3500	LD	(F8), A
0318 3A 48 08	3510	LD	A, (B8)
031B 32 42 08	3520	LD	(R8), A
031E 78	3530	LD	A, B
031F 32 48 08	3540	LD	(B8), A
0322 3A 38 08	3550	LD	A, (L9)
0325 47	3560	LD	B, A
0326 3A 3E 08	3570	LD	A, (F9)
0329 32 38 08	3580	LD	(L9), A
032C 3A 44 08	3590	LD	A, (R9)
032F 32 3E 08	3600	LD	(F9), A
0332 3A 4A 08	3610	LD	A, (B9)
0335 32 44 08	3620	LD	(R9), A
0338 78	3630	LD	A, B
0339 32 4A 08	3640	LD	(B9), A
033C C3 C4 00	3650	JP	DISPLY
033F	3660	*	
033F	3670	* L = LEFT SURFACE, CLOCKWISE	
033F	3680	*	
033F CF	3690	LTRT	RST 10
0340 3A 04 08	3700	LD	A, (L1)
0343 47	3710	LD	B, A
0344 3A 34 08	3720	LD	A, (L7)
0347 32 04 08	3730	LD	(L1), A
034A 3A 38 08	3740	LD	A, (L9)
034D 32 34 08	3750	LD	(L7), A
0350 3A 08 08	3760	LD	A, (L3)
0353 32 38 08	3770	LD	(L9), A

More →

Listing 2 continued.

0356 78	3780	LD	A, B
0357 32 08 08	3790	LD	(L3), A
035A 3A 06 08	3800	LD	A, (L2)
035D 47	3810	LD	B, A
035E 3A 1C 08	3820	LD	A, (L4)
0361 32 06 08	3830	LD	(L2), A
0364 3A 36 08	3840	LD	A, (L8)
0367 32 1C 08	3850	LD	(L4), A
036A 3A 20 08	3860	LD	A, (L6)
036D 32 36 08	3870	LD	(L8), A
0370 78	3880	LD	A, B
0371 32 20 08	3890	LD	(L6), A
0374 3A F2 07	3900	LD	A, (U1)
0377 47	3910	LD	B, A
0378 3A 4A 08	3920	LD	A, (B9)
037B 32 F2 07	3930	LD	(U1), A
037E 3A 4C 08	3940	LD	A, (D1)
0381 32 4A 08	3950	LD	(B9), A
0384 3A 0A 08	3960	LD	A, (F1)
0387 32 4C 08	3970	LD	(D1), A
038A 78	3980	LD	A, B
038B 32 0A 08	3990	LD	(F1), A
038E 3A FB 07	4000	LD	A, (U4)
0391 47	4010	LD	B, A
0392 3A 32 08	4020	LD	A, (B6)
0395 32 F8 07	4030	LD	(U4), A
0398 3A 52 08	4040	LD	A, (D4)
039B 32 32 08	4050	LD	(B6), A
039E 3A 22 08	4060	LD	A, (F4)
03A1 32 52 08	4070	LD	(D4), A
03A4 78	4080	LD	A, B
03A5 32 22 08	4090	LD	(F4), A
03A8 3A FE 07	4100	LD	A, (U7)
03AB 47	4110	LD	B, A
03AC 3A 1A 08	4120	LD	A, (B3)
03AF 32 FE 07	4130	LD	(U7), A
03B2 3A 58 08	4140	LD	A, (D7)
03B5 32 1A 08	4150	LD	(B3), A
03B8 3A 3A 08	4160	LD	A, (F7)
03BB 32 58 08	4170	LD	(D7), A
03BE 78	4180	LD	A, B
03BF 32 3A 08	4190	LD	(F7), A
03C2 C3 C4 00	4200	JP	DISPLY
03C5	4210 *		
03C5	4220 *	1 = LEFT SURFACE, COUNTERCLOCKWISE	
03C5	4230 *		
03C5 CF	4240	LTLT	RST 10
03C6 3A 04 08	4250	LD	A, (L1)
03C9 47	4260	LD	B, A
03CA 3A 08 08	4270	LD	A, (L3)
03CD 32 04 08	4280	LD	(L1), A
03D0 3A 38 08	4290	LD	A, (L9)
03D3 32 08 08	4300	LD	(L3), A
03D6 3A 34 08	4310	LD	A, (L7)
03D9 32 38 08	4320	LD	(L9), A
03DC 78	4330	LD	A, B
03DD 32 34 08	4340	LD	(L7), A
03E0 3A 06 08	4350	LD	A, (L2)
03E3 47	4360	LD	B, A
03E4 3A 20 08	4370	LD	A, (L6)
03E7 32 06 08	4380	LD	(L2), A
03EA 3A 36 08	4390	LD	A, (L8)
03ED 32 20 08	4400	LD	(L6), A
03F0 3A 1C 08	4410	LD	A, (L4)
03F3 32 36 08	4420	LD	(L8), A
03F6 78	4430	LD	A, B
03F7 32 1C 08	4440	LD	(L4), A
03FA 3A F2 07	4450	LD	A, (U1)
03FD 47	4460	LD	B, A
03FE 3A 0A 08	4470	LD	A, (F1)
0401 32 F2 07	4480	LD	(U1), A
0404 3A 4C 08	4490	LD	A, (D1)
0407 32 0A 08	4500	LD	(F1), A
040A 3A 4A 08	4510	LD	A, (B9)
040D 32 4C 08	4520	LD	(D1), A
0410 78	4530	LD	A, B
0411 32 4A 08	4540	LD	(B9), A
0414 3A F8 07	4550	LD	A, (U4)
0417 47	4560	LD	B, A
0418 3A 22 08	4570	LD	A, (F4)
041B 32 F8 07	4580	LD	(U4), A
041E 3A 52 08	4590	LD	A, (D4)
0421 32 22 08	4600	LD	(F4), A
0424 3A 32 08	4610	LD	A, (B6)

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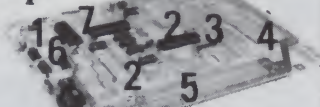
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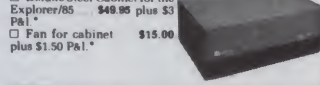


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caution: most patterns are not simple, and trying can be addictive!

Future Prospects

While it is beyond the scope of the programs offered here, far greater capability for Rubik's Cube simulation can be achieved. For example, a simple utility might be devised to preset a desired pattern on each face; this would be useful in discovering routines to move from one arrangement to another, or in unscrambling a scrambled Cube. Naturally, care would have to be exercised to ensure that "fixed adjacencies" (the invariable relationships at edges and corners) are not violated in such a preset capability.

Readers with more sophisticated graphics capability may wish to pursue some of the obvious extensions suggested by the basic concepts. The possibilities promised by full color and/or 3-D graphics are truly exciting.

Conclusion

While this application certainly falls into the games category, these are not game programs in the usual

Listing 2 continued.

0427 32 52 08	4620	LD (D4), A
042A 78	4630	LD A, B
042B 32 32 08	4640	LD (B6), A
042E 3A FE 07	4650	LD A, (U7)
0431 47	4660	LD B, A
0432 3A 3A 08	4670	LD A, (F7)
0435 32 FE 07	4680	LD (U7), A
0438 3A 58 08	4690	LD A, (D7)
043B 32 3A 08	4700	LD (F7), A
043E 3A 1A 08	4710	LD A, (B3)
0441 32 58 08	4720	LD (D7), A
0444 78	4730	LD A, B
0445 32 1A 08	4740	LD (B3), A
0448 C3 C4 00	4750	JP DISPLY
044B	4760 *	
044B	4770	* R = RIGHT SURFACE, CLOCKWISE
044B	4780 *	
044B CF	4790	RTRT RST 10
044C 3A 10 08	4800	LD A, (R1)
044F 47	4810	LD B, A
0450 3A 40 08	4820	LD A, (R7)
0453 32 10 08	4830	LD (R1), A
0456 3A 44 08	4840	LD A, (R9)
0459 32 40 08	4850	LD (R7), A
045C 3A 14 08	4860	LD A, (R3)
045F 32 44 08	4870	LD (R9), A
0462 78	4880	LD A, B
0463 32 14 08	4890	LD (R3), A
0466 3A 12 08	4900	LD A, (R2)
0469 47	4910	LD B, A
046A 3A 28 08	4920	LD A, (R4)
046D 32 12 08	4930	LD (R2), A
0470 3A 42 08	4940	LD A, (R8)
0473 32 28 08	4950	LD (R4), A
0476 3A 2C 08	4960	LD A, (R6)
0479 32 42 08	4970	LD (R8), A
047C 78	4980	LD A, B
047D 32 2C 08	4990	LD (R6), A

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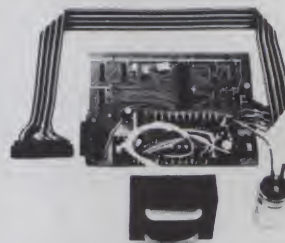
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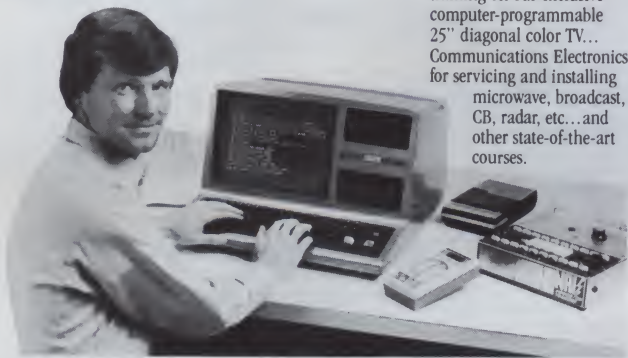
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sense. More properly, they are problem-solving tools, representative of ways computers are used in scientific and engineering applications in industry and research. As with most computer applications, potential extensions to these programs range from the obvious and simple to the subtle and sophisticated.

In the *Scientific American* article, Hofstadter loosely associates Rubik's Cube with the once-popular and much older two-dimensional Fifteen Puzzle. An article and TRS-80 BASIC program for that puzzle, written by William L. Colsher, appeared in the February 1981 issue of *Microcomputing*. As awesome as the number of Fifteen Puzzle solutions may appear, Rubik's Cube makes the Fifteen Puzzle seem trivial by contrast: the cube has more than four million times as many solutions!

Even with the best of computer technology, it is improbable that every cube solution will ever be achieved. One hundred million computerized cubists, each producing solutions at the rate of one per second, would require more than 13,000 years to complete the task. ■

Listing 2 continued.

0480 3A F6 07	5000	LD	A, (U3)
0483 47	5010	LD	B, A
0484 3A 0E 08	5020	LD	A, (F3)
0487 32 F6 07	5030	LD	(U3), A
048A 3A 50 08	5040	LD	A, (D3)
048D 32 0E 08	5050	LD	(F3), A
0490 3A 46 08	5060	LD	A, (B7)
0493 32 50 08	5070	LD	(D3), A
0496 78	5080	LD	A, B
0497 32 46 08	5090	LD	(B7), A
049A 3A FC 07	5100	LD	A, (U6)
049D 47	5110	LD	B, A
049E 3A 26 08	5120	LD	A, (F6)
04A1 32 FC 07	5130	LD	(U6), A
04A4 3A 56 08	5140	LD	A, (D6)
04A7 32 26 08	5150	LD	(F6), A
04AA 3A 2E 08	5160	LD	A, (B4)
04AD 32 56 08	5170	LD	(D6), A
04B0 78	5180	LD	A, B
04B1 32 2E 08	5190	LD	(B4), A
04B4 3A 02 08	5200	LD	A, (U9)
04B7 47	5210	LD	B, A
04B8 3A 3E 08	5220	LD	A, (F9)
04BB 32 02 08	5230	LD	(U9), A
04BE 3A 5C 08	5240	LD	A, (D9)
04C1 32 3E 08	5250	LD	(F9), A
04C4 3A 16 08	5260	LD	A, (B1)
04C7 32 5C 08	5270	LD	(D9), A
04CA 78	5280	LD	A, B
04CB 32 16 08	5290	LD	(B1), A
04CE C3 C4 00	5300	JP	DISPLY
04D1	5310 *		
04D1	5320 * r =	RIGHT SURFACE, COUNTERCLOCKWISE	
04D1	5330 *		
04D1 CF	5340	RTLT	RST 10
04D2 3A 10 08	5350	LD	A, (R1)
04D5 47	5360	LD	B, A
04D6 3A 14 08	5370	LD	A, (R3)

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04D9 32 10 08	5380	LD	(R1), A
04DC 3A 44 08	5390	LD	A, (R9)
04DF 32 14 08	5400	LD	(R3), A
04E2 3A 40 08	5410	LD	A, (R7)
04E5 32 44 08	5420	LD	(R9), A
04E8 78	5430	LD	A, B
04E9 32 40 08	5440	LD	(R7), A
04EC 3A 12 08	5450	LD	A, (R2)
04EF 47	5460	LD	B, A
04F0 3A 2C 08	5470	LD	A, (R6)
04F3 32 12 08	5480	LD	(R2), A
04F6 3A 42 08	5490	LD	A, (R8)
04F9 32 2C 08	5500	LD	(R6), A
04FC 3A 28 08	5510	LD	A, (R4)
04FF 32 42 08	5520	LD	(R8), A
0502 78	5530	LD	A, B
0503 32 28 08	5540	LD	(R4), A
0506 3A F6 07	5550	LD	A, (U3)
0509 47	5560	LD	B, A
050A 3A 46 08	5570	LD	A, (B7)
050D 32 F6 07	5580	LD	(U3), A
0510 3A 50 08	5590	LD	A, (D3)
0513 32 46 08	5600	LD	(B7), A
0516 3A 0E 08	5610	LD	A, (F3)
0519 32 50 08	5620	LD	(D3), A
051C 78	5630	LD	A, B
051D 32 0E 08	5640	LD	(F3), A
0520 3A FC 07	5650	LD	A, (U6)
0523 47	5660	LD	B, A
0524 3A 2E 08	5670	LD	A, (B4)
0527 32 FC 07	5680	LD	(U6), A
052A 3A 56 08	5690	LD	A, (D6)
052D 32 2E 08	5700	LD	(B4), A
0530 3A 26 08	5710	LD	A, (F6)
0533 32 56 08	5720	LD	(D6), A
0536 78	5730	LD	A, B
0537 32 26 08	5740	LD	(F6), A
053A 3A 02 08	5750	LD	A, (U9)
053D 47	5760	LD	B, A
053E 3A 16 08	5770	LD	A, (B1)
0541 32 02 08	5780	LD	(U9), A
0544 3A 5C 08	5790	LD	A, (D9)
0547 32 16 08	5800	LD	(B1), A
054A 3A 3E 08	5810	LD	A, (F9)
054D 32 5C 08	5820	LD	(D9), A
0550 78	5830	LD	A, B
0551 32 3E 08	5840	LD	(F9), A
0554 C3 C4 00	5850	JP	DISPLY
0557	5860 *		
0557	5870 * F = FRONT SURFACE, CLOCKWISE		
0557	5880 *		
0557 CF	5890 FRRT RST 10		
0558 3A 0A 08	5900	LD	A, (F1)
055B 47	5910	LD	B, A
055C 3A 3A 08	5920	LD	A, (F7)
055F 32 0A 08	5930	LD	(F1), A
0562 3A 3E 08	5940	LD	A, (F9)
0565 32 3A 08	5950	LD	(F7), A
0568 3A 0E 08	5960	LD	A, (F3)
056B 32 3E 08	5970	LD	(F9), A
056E 78	5980	LD	A, B
056F 32 0E 08	5990	LD	(F3), A
0572 3A 0C 08	6000	LD	A, (F2)
0575 47	6010	LD	B, A
0576 3A 22 08	6020	LD	A, (F4)
0579 32 0C 08	6030	LD	(F2), A
057C 3A 3C 08	6040	LD	A, (F6)
057F 32 22 08	6050	LD	(F4), A
0582 3A 26 08	6060	LD	A, (F6)
0585 32 3C 08	6070	LD	(F8), A
0588 78	6080	LD	A, B
0589 32 26 08	6090	LD	(F6), A
058C 3A FE 07	6100	LD	A, (U7)
058F 47	6110	LD	B, A
0590 3A 38 08	6120	LD	A, (L9)
0593 32 FE 07	6130	LD	(U7), A
0596 3A 50 08	6140	LD	A, (D3)
0599 32 38 08	6150	LD	(L9), A
059C 3A 10 08	6160	LD	A, (R1)
059F 32 50 08	6170	LD	(D3), A
05A2 78	6180	LD	A, B
05A3 32 10 08	6190	LD	(R1), A
05A6 3A 00 08	6200	LD	A, (U8)
05A9 47	6210	LD	B, A

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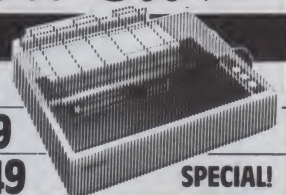
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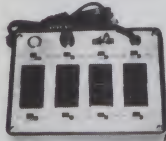
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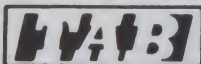
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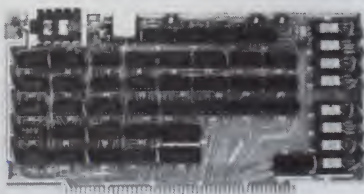
nationwide 1-800-874-1551

Listing 2 continued.

05AA	3A	20	08	6220	LD	A, (L6)
05AD	32	00	08	6230	LD	(U8), A
05B0	3A	4E	08	6240	LD	A, (D2)
05B3	32	20	08	6250	LD	(L6), A
05B6	3A	28	08	6260	LD	A, (R4)
05B9	32	4E	08	6270	LD	(D2), A
05BC	78			6280	LD	A, B
05BD	32	28	08	6290	LD	(R4), A
05C0	3A	02	08	6300	LD	A, (U9)
05C3	47			6310	LD	B, A
05C4	3A	08	08	6320	LD	A, (L3)
05C7	32	02	08	6330	LD	(U9), A
05CA	3A	4C	08	6340	LD	A, (D1)
05CD	32	08	08	6350	LD	(L3), A
05D0	3A	40	08	6360	LD	A, (R7)
05D3	32	4C	08	6370	LD	(D1), A
05D6	78			6380	LD	A, B
05D7	32	40	08	6390	LD	(R7), A
05DA	C3	C4	00	6400	JP	DISPLY
05DD				6410	*	
05DD				6420	* f =	FRONT SURFACE, COUNTERCLOCKWISE
05DD				6430	*	
05DD	CF			6440	FRLT	RST 10
05DE	3A	0A	08	6450	LD	A, (F1)
05E1	47			6460	LD	B, A
05E2	3A	0E	08	6470	LD	A, (F3)
05E5	32	0A	08	6480	LD	(F1), A
05E8	3A	3E	08	6490	LD	A, (F9)
05EB	32	0E	08	6500	LD	(F3), A
05EE	3A	3A	08	6510	LD	A, (F7)
05F1	32	3E	08	6520	LD	(F9), A
05F4	78			6530	LD	A, B
05F5	32	3A	08	6540	LD	(F7), A
05F8	3A	0C	08	6550	LD	A, (F2)
05FB	47			6560	LD	B, A
05FC	3A	26	08	6570	LD	A, (F6)
05FF	32	0C	08	6580	LD	(F2), A
0602	3A	3C	08	6590	LD	A, (F8)
0605	32	26	08	6600	LD	(F6), A
0608	3A	22	08	6610	LD	A, (F4)
060B	32	3C	08	6620	LD	(F8), A
060E	78			6630	LD	A, B
060F	32	22	08	6640	LD	(F4), A
0612	3A	FE	07	6650	LD	A, (U7)
0615	47			6660	LD	B, A
0616	3A	10	08	6670	LD	A, (R1)
0619	32	FE	07	6680	LD	(U7), A
061C	3A	50	08	6690	LD	A, (D3)
061F	32	10	08	6700	LD	(R1), A
0622	3A	38	08	6710	LD	A, (L9)
0625	32	50	08	6720	LD	(D3), A
0628	78			6730	LD	A, B
0629	32	38	08	6740	LD	(L9), A
062C	3A	00	08	6750	LD	A, (U8)
062F	47			6760	LD	B, A
0630	3A	28	08	6770	LD	A, (R4)
0633	32	00	08	6780	LD	(U8), A
0636	3A	4E	08	6790	LD	A, (D2)
0639	32	28	08	6800	LD	(R4), A
063C	3A	20	08	6810	LD	A, (L6)
063F	32	4E	08	6820	LD	(D2), A
0642	78			6830	LD	A, B
0643	32	20	08	6840	LD	(L6), A
0646	3A	02	08	6850	LD	A, (U9)
0649	47			6860	LD	B, A
064A	3A	40	08	6870	LD	A, (R7)
064D	32	02	08	6880	LD	(U9), A
0650	3A	4C	08	6890	LD	A, (D1)
0653	32	40	08	6900	LD	(R7), A
0656	3A	08	08	6910	LD	A, (L3)
0659	32	4C	08	6920	LD	(D1), A
065C	78			6930	LD	A, B
065D	32	08	08	6940	LD	(L3), A
0660	C3	C4	00	6950	JP	DISPLY
0663				6960	*	
0663				6970	* B =	BACK SURFACE, CLOCKWISE
0663				6980	*	
0663	CF			6990	BKRT	RST 10
0664	3A	16	08	7000	LD	A, (B1)
0667	47			7010	LD	B, A
0668	3A	46	08	7020	LD	A, (B7)
066B	32	16	08	7030	LD	(B1), A
066E	3A	4A	08	7040	LD	A, (B9)
0671	32	46	08	7050	LD	(B7), A

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- RS204 TRS-80 Model III 129
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- AT301 Atari Computer & Accessories 109
- P401 Paper Tiger 440/445/460 99
- P402 Centronics 730/737 Line Printer II/IV 89
- P403 Epson MX70 or MX80 89
- P404 Epson MX100 99
- CC90 Matching Attaché Case 75

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CPC-2813 CPU-I/O	460	365
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Datatar	350	250
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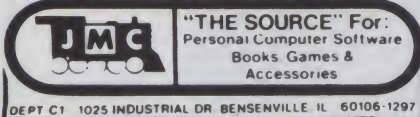
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Listing 2 continued.

0674	3A	1A	08	7060	LD	A, (B3)
0677	32	4A	08	7070	LD	(B9), A
067A	78			7080	LD	A, B
067B	32	1A	08	7090	LD	(B3), A
067E	3A	18	08	7100	LD	A, (B2)
0681	47			7110	LD	B, A
0682	3A	2E	08	7120	LD	A, (B4)
0685	32	18	08	7130	LD	(B2), A
0688	3A	48	08	7140	LD	A, (B8)
068B	32	2E	08	7150	LD	(B4), A
068E	3A	32	08	7160	LD	A, (B6)
0691	32	48	08	7170	LD	(B8), A
0694	78			7180	LD	A, B
0695	32	32	08	7190	LD	(B6), A
0698	3A	F2	07	7200	LD	A, (U1)
069B	47			7210	LD	B, A
069C	3A	14	08	7220	LD	A, (R3)
069F	32	F2	07	7230	LD	(U1), A
06A2	3A	5C	08	7240	LD	A, (D9)
06A5	32	14	08	7250	LD	(R3), A
06A8	3A	34	08	7260	LD	A, (L7)
06AB	32	5C	08	7270	LD	(D9), A
06AE	78			7280	LD	A, B
06AF	32	34	08	7290	LD	(L7), A
06B2	3A	F4	07	7300	LD	A, (U2)
06B5	47			7310	LD	B, A
06B6	3A	2C	08	7320	LD	A, (R6)
06B9	32	F4	07	7330	LD	(U2), A
06BC	3A	5A	08	7340	LD	A, (D8)
06BF	32	2C	08	7350	LD	(R6), A
06C2	3A	1C	08	7360	LD	A, (L4)
06C5	32	5A	08	7370	LD	(D8), A
06C8	78			7380	LD	A, B
06C9	32	1C	08	7390	LD	(L4), A
06CC	3A	F6	07	7400	LD	A, (U3)
06CF	47			7410	LD	B, A
06D0	3A	44	08	7420	LD	A, (R9)
06D3	32	F6	07	7430	LD	(U3), A
06D6	3A	58	08	7440	LD	A, (D7)
06D9	32	44	08	7450	LD	(R9), A
06DC	3A	04	08	7460	LD	A, (L1)
06DF	32	58	08	7470	LD	(D7), A
06E2	78			7480	LD	A, B
06E3	32	04	08	7490	LD	(L1), A
06E6	C3	C4	00	7500	JP	DISPLY
06E9				7510	*	
06E9				7520	* b =	BACK SURFACE, COUNTERCLOCKWISE
06E9				7530	*	
06E9	CF			7540	BKLT	RST 10
06EA	3A	16	08	7550	LD	A, (B1)
06ED	47			7560	LD	B, A
06EE	3A	1A	08	7570	LD	A, (B3)
06F1	32	16	08	7580	LD	(B1), A
06F4	3A	4A	08	7590	LD	A, (B9)
06F7	32	1A	08	7600	LD	(B3), A
06FA	3A	46	08	7610	LD	A, (B7)
06FD	32	4A	08	7620	LD	(B9), A
0700	78			7630	LD	A, B
0701	32	46	08	7640	LD	(B7), A
0704	3A	18	08	7650	LD	A, (B2)
0707	47			7660	LD	B, A
0708	3A	32	08	7670	LD	A, (B6)
070B	32	18	08	7680	LD	(B2), A
070E	3A	48	08	7690	LD	A, (B8)
0711	32	32	08	7700	LD	(B6), A
0714	3A	2E	08	7710	LD	A, (B4)
0717	32	48	08	7720	LD	(B8), A
071A	78			7730	LD	A, B
071B	32	2E	08	7740	LD	(B4), A
071E	3A	F2	07	7750	LD	A, (U1)
0721	47			7760	LD	B, A
0722	3A	34	08	7770	LD	A, (L7)
0725	32	F2	07	7780	LD	(U1), A
0728	3A	5C	08	7790	LD	A, (D9)
072B	32	34	08	7800	LD	(L7), A
072E	3A	14	08	7810	LD	A, (R3)
0731	32	5C	08	7820	LD	(D9), A
0734	78			7830	LD	A, B
0735	32	14	08	7840	LD	(R3), A
0738	3A	F4	07	7850	LD	A, (U2)
073B	47			7860	LD	B, A
073C	3A	1C	08	7870	LD	A, (L4)
073F	32	F4	07	7880	LD	(U2), A
0742	3A	5A	08	7890	LD	A, (D8)

More

Listing 2 continued.

0745	32	1C	08	7900	LD	(L4),A
0748	3A	2C	08	7910	LD	A,(R6)
074B	32	5A	08	7920	LD	(D8),A
074E	78			7930	LD	A,B
074F	32	2C	08	7940	LD	(R6),A
0752	3A	F6	07	7950	LD	A,(U3)
0755	47			7960	LD	B,A
0756	3A	04	08	7970	LD	A,(L1)
0759	32	F6	07	7980	LD	(U3),A
075C	3A	58	08	7990	LD	A,(D7)
075F	32	04	08	8000	LD	(L1),A
0762	3A	44	08	8010	LD	A,(R9)
0765	32	58	08	8020	LD	(D7),A
0768	78			8030	LD	A,B
0769	32	44	08	8040	LD	(R9),A
076C	C3	C4	00	8050	JP	DISPLY
076F				8060 *		
076F				8070 *	COMBINED DATA AND SCREEN FORMAT STORAGE AREA	
076F				8080 *	EDITOR INTERPRETS BYTES WITH MSB SET (200-376)	
076F				8090 *	AS CORRESPONDING ASCII CHARACTER; BYTES WITH	
076F				8100 *	MSB CLEAR (001-177) ARE INTERPRETED AS MULTIPLE	
076F				8110 *	SPACES. "377" ERASES SCREEN. "000" MARKS END	
076F				8120 *	OF MESSAGE.	
076F				8130 *		
076F				8140	SCREEN DB	377,'Move Sequence: '
	FF	CD	EF	F6	E5	
	A0	D3	E5	F1	F5	
	E5	EE	E3	E5	BA	
	A0					
077F				8150	MOVES DB	'
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0				
079F				8160	DB	'
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0				
07BF				8170	DB	'
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0				
07DF				8180	DB	' ,83D
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0	A0	A0	A0	
	A0	A0				
07F2				8190 *		
07F2				8200 *	LABELS BELOW (U1, U2, ETC.) PERMIT ASSEMBLER	
07F2				8210 *	TO TREAT CORRESPONDING ADDRESSES AS	
07F2				8220 *	LOCATIONS OF LITERAL VARIABLES.	
07F2				8230 *		
07F2				8240	U1 DB	'U',2
	D5	02				
07F4				8250	U2 DB	'U',2
	D5	02				
07F6				8260	U3 DB	'U',57D
	D5	39				
07F8				8270	U4 DB	'U',2
	D5	02				
07FA				8280	U5 DB	'U',2
	D5	02				
07FC				8290	U6 DB	'U',57D
	D5	39				
07FE				8300	U7 DB	'U',2
	D5	02				
0800				8310	U8 DB	'U',2
	D5	02				
0802				8320	U9 DB	'U',110D
	D5	6E				
0804				8330	L1 DB	'L',2
	CC	02				
0806				8340	L2 DB	'L',2

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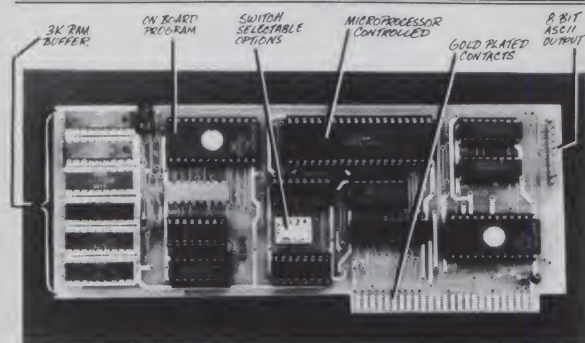
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Listing 2 continued.

CC	02			
0808		8350 L3	DB	'L',4
CC	04			
080A		8360 F1	DB	'F',2
C6	02			
080C		8370 F2	DB	'F',2
C6	02			
080E		8380 F3	DB	'F',4
C6	04			
0810		8390 R1	DB	'R',2
D2	02			
0812		8400 R2	DB	'R',2
D2	02			
0814		8410 R3	DB	'R',4
D2	04			
0816		8420 B1	DB	'B',2
C2	02			
0818		8430 B2	DB	'B',2
C2	02			
081A		8440 B3	DB	'B',24D
C2	18			
081C		8450 L4	DB	'L',2
CC	02			
081E		8460 L5	DB	'L',2
CC	02			
0820		8470 L6	DB	'L',4
CC	04			
0822		8480 F4	DB	'F',2
C6	02			
0824		8490 F5	DB	'F',2
C6	02			
0826		8500 F6	DB	'F',4
C6	04			
0828		8510 R4	DB	'R',2
D2	02			
082A		8520 R5	DB	'R',2
D2	02			
082C		8530 R6	DB	'R',4
D2	04			
082E		8540 B4	DB	'B',2
C2	02			
0830		8550 B5	DB	'B',2
C2	02			
0832		8560 B6	DB	'B',24D
C2	18			
0834		8570 L7	DB	'L',2
CC	02			
0836		8580 L8	DB	'L',2
CC	02			
0838		8590 L9	DB	'L',4
CC	04			
083A		8600 F7	DB	'F',2
C6	02			
083C		8610 F8	DB	'F',2
C6	02			
083E		8620 F9	DB	'F',4
C6	04			
0840		8630 R7	DB	'R',2
D2	02			
0842		8640 R8	DB	'R',2
D2	02			
0844		8650 R9	DB	'R',4
D2	04			
0846		8660 B7	DB	'B',2
C2	02			
0848		8670 B8	DB	'B',2
C2	02			
084A		8680 B9	DB	'B',99D
C2	63			
084C		8690 D1	DB	'D',2
C4	02			
084E		8700 D2	DB	'D',2
C4	02			
0850		8710 D3	DB	'D',57D
C4	39			
0852		8720 D4	DB	'D',2
C4	02			
0854		8730 D5	DB	'D',2
C4	02			
0856		8740 D6	DB	'D',57D
C4	39			
0858		8750 D7	DB	'D',2
C4	02			
085A		8760 D8	DB	'D',2

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C4      02      8770 D9      DB      'D',101D,'Next Move: ',0
085C
C4      65      CE      E5      F8
F4      A0      CD      EF      F6
E5      BA      A0      00
086A      8780 *
086A      8790 * END OF MAIN PROGRAM
086A      8800 *
086A      8810 STACK DS 32D
088A      8820 STAK EQU $
088A      8830 *
088A      8840 EDITOR EQU 343210      EDITS MESSAGE TO CRT
088A      8850 KEYIN EQU 343152      RETURNS KEYSTROKE IN A
088A      8860 TRMOUT EQU 363160      OUTPUTS A CONTENTS TO CRT
088A      8870 MONITR EQU 340000      MONITOR/OPERATING SYSTEM
088A      8880 *
088A      8890 * PRINT ROUTINE - USER SHOULD SUPPLY APPROPRIATE
088A      8900 * ROUTINE TO REPRODUCE CONTENTS OF
088A      8910 * VIDEO DISPLAY ON HARDCOPY DEVICE
088A      8920 *
088A C5      8930 PRINT PUSH BC
088B 21 AF F0 8940 LD HL,PBUF+100
088E 22 D3 EF 8950 LD (BFNDST+1),HL
0891 CD A3 E3 8960 CALL ERASE
0894 3E OD 8970 LD A,15
0896 F7 8980 RST 60
0897 32 1D F3 8990 LD (PRTFLG),A
089A 21 70 07 9000 LD HL,SCREEN+1
089D D7 9010 RST 20
089E AF 9020 XOR A
089F 32 1D F3 9030 LD (PRTFLG),A
08A2 21 CF F0 9040 LD HL,BUFEND
08A5 22 D3 EF 9050 LD (BFNDST+1),HL
08A8 06 09 9060 LD B,9D
08AA 3E OD 9070 LD A,15
08AC F7 9080 FORMOT RST 60
08AD 10 FD 9090 DJNZ FORMOT
08AF C1 9100 POP BC
08B0 C9 9110 RET
08B1 9120 *
08B1 9130 * JUMP/CALL TABLE OF SUBROUTINES IN
08B1 9140 * * AUTHOR'S OPERATING SYSTEM/MONITOR
08B1 9150 *
08B1 9160 PRTFLG EQU 363035
08B1 9170 BUFEND EQU 360317
08B1 9180 BFNDST EQU 357322
08B1 9190 PBUF EQU 360157
08B1 9200 ERASE EQU 343243
08B1 9210 LPRTR EQU 357260
08B1 9220 *
08B1 9999 * END OF PRINT ROUTINE
```

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B1	0816	B2	0818	B3	081A	B4	082E
B5	0830	B6	0832	B7	0846	B8	0848
B9	084A	BEGIN	0017	BEGIN1	0022	BFNDST	EFD2
BKLT	06E9	BKRT	0663	BUFEND	F0CF	D1	084C
D2	084E	D3	0850	D4	0852	D5	0854
D6	0856	D7	0858	D8	085A	D9	085C
DISPLY	00C4	DNLT	02B9	DNRT	0233	EDITOR	E388
ERASE	E3A3	F1	080A	F2	080C	F3	080E
F4	0822	F5	0824	F6	0826	F7	083A
F8	083C	F9	083E	FORMOT	08AC	FRLT	05DD
FRRT	0557	GETCMD	00CA	INIT	0028	KEYIN	E36A
L1	0804	L2	0806	L3	0808	L4	081C
L5	081E	L6	0820	L7	0834	L8	0836
L9	0838	LPRTR	EFB0	LTLT	03C5	LTRT	033F
MONITR	E000	MOVES	077F	PBUF	F06F	PRINT	088A
PRTFLG	F31D	R1	0810	R2	0812	R3	0814
R4	0828	R5	082A	R6	082C	R7	0840
R8	0842	R9	0844	RTLT	04D1	RTRT	044B
SCREEN	076F	STACK	086A	STAK	088A	START	0000
TRMOUT	F370	U1	07F2	U2	07F4	U3	07F6
U4	07F8	U5	07FA	U6	07FC	U7	07FE
U8	0800	U9	0802	UPDATE	0118	UPLT	01AD
UPRT	0127						

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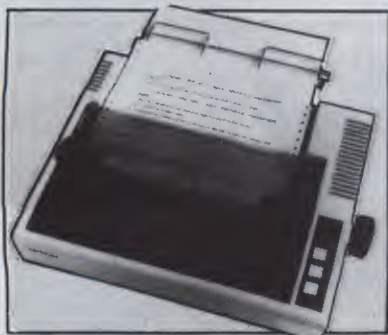
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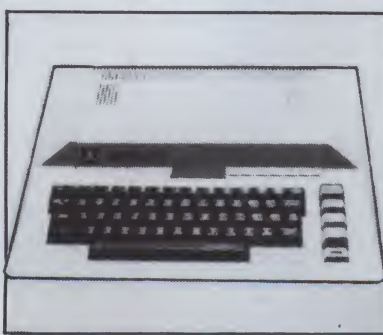
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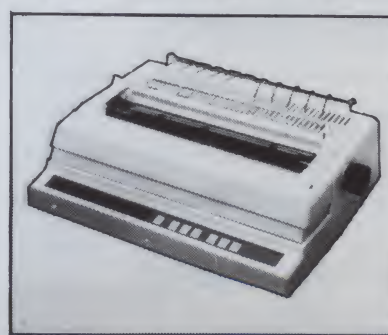
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Micros in Science

By Harry Nelson

Microcomputing Technical Editor

Micros Practice Science

The sciences—human, social, biological and physical—have all required frequent and often very complex mathematical calculations. It is hardly surprising that scientists and students of science have sought better and better aids for performing calculations that are extremely repetitious, almost incomprehensibly complicated or simply very lengthy. Some early thinkers developed crude mechanical calculating devices. The trusty old slide rule was indispensable in situations that did not require more than a few decimal places of accuracy. Mainframe and then minicomputers have been a very expensive solution. Small calculators were much more accurate than the slide rules but could not handle or store data as the computers could.

The result was that large projects with very large budgets got their own computers. Smaller projects, labs, and science education facilities got access to time-sharing systems—when they were lucky. Even those that did have access to a large system were often not lucky. Sometimes access was restricted to unusual hours, and if the system went down the only options were to just wait or do the work by hand.

It didn't take scientists long to realize that the computer could do more for them than just serve as a high-powered and expensive calculator. Computer models could be designed to simulate a variety of situations scientists wanted to study. And this could be done interactively with the researcher changing parameters of the situation being investigated to observe possible results. Computers could also be programmed to control experiments and record and analyze

data from them. Again, as long as a project could maintain its own computer, there was little problem. But time-sharing presented more difficulties in these applications than in strict calculating operations.

Within the past few years many scientists have been discovering a powerful new tool that can be used in a variety of ways in their research. The microcomputer, used in conjunction with a larger system or as a stand-alone system, has started to emerge as a valuable tool for many scientific applications.

Sidney Fernbach, deputy associate director for scientific support at the Lawrence Livermore Laboratory, is a more than credible witness to this tendency (see "Scientific Use of Computers" in *The Computer Age: A Twenty-Year View*, edited by Michael L. Dertouzos and Joel Moses, The MIT Press, Cambridge, MA, 1979, p. 146). He says, "While the scientific community has been the user of most of the large computers built, interestingly enough, it also uses most of the minicomputers (and now microcomputers). . . . There is no doubt that the minicomputer will continue to be used heavily in the scientific laboratory . . . (but) growing availability and improving performance of microprocessors may change this somewhat

. . . . It seems clear that every experiment will have one or more processors tied to it for control, data acquisition and data analysis purposes. . . . Soon we will find the microprocessors far outnumber the minis."

Expanding on scientific networks, Fernbach writes, "What I picture is networks made up of computers of all varieties. These can be local networks or local networks tied to any number of remote systems. In each

there will be a set of functional boxes or computers dedicated to specific functions. One or more may do nothing but print, another plot, another create pictures on film, another retrieve information from a local data bank. In other words, instead of a large-scale general purpose computer, I visualize a distributed system in which specific jobs are parceled out to specialists."

Fernbach's vision of only two years ago is reality today. There are a number of small (and I might add inexpensive) microcomputers available that are ideal, and in some cases have been designed for such dedicated single-functions jobs as equipment control and data acquisition. (See, for example, "Everyman's Computer System" by J. McKown and S. Sarns, *Microcomputing*, Dec. 1981, p. 32.)

Distributed intelligence networks are becoming almost commonplace. They are appearing in business offices as well as scientific laboratories (not to mention the Children's Television Workshop's Sesame Place). (See "(Distributed) Intelligence Networks in the Office" by Michael Brandt and Michael Bodner, *Microcomputing*, Oct. 1981, p. 80.)

Personal microcomputers are being used by many scientists today. One very interesting example involves some recent discoveries in "experimental" mathematics (that's right, there is such a thing as empirical mathematics and discoveries is the correct word to use for findings in that area). M. J. Feigenbaum of the Los Alamos National Laboratory has found some important characteristics of the phenomena known as *strange attractors* that occur in a variety of systems of interest to scientists ranging from meteorologists to physicists. (For an engaging introduction to this

fascinating topic see Douglas Hofstadter's "Metamagical Themas" column in the Nov. 1981 *Scientific American*, p. 22.) One thing that is striking about Feigenbaum's work, in the present context, is that some of his very important discoveries were made with the aid of a small computer and a calculator.

(The mention of meteorologists calls a recent news item to mind. The National Weather Service is in the process of installing a large national minicomputer-based system. But in the meantime, directors of some weather service centers have decided to purchase and use Zenith Z-89 microcomputers with modems rather than wait for completion of the large system.)

The science-related articles that follow, in addition to describing specific uses of microcomputers, indicate something of the flexibility and range of possible science applications. Obviously, we could not hope to cover the entire spectrum in a single issue. So, from time to time we will be printing more material on uses of micros in the sciences.

It also seems worth noting that new products are beginning to appear that facilitate the use of off-the-shelf microcomputers in the science lab. One such product, called Isaac (Cyborg Corp., Boston, MA), allows you to use an Apple for instrument control, data acquisition, electronic testing and process control. The manufacturer claims it can be easily used for applications in chemistry, engineering, psychology and physiology. It sounds like it turns a standard Apple into a versatile laboratory machine.

Cubist's Corner

Rubik's Cube has become so popular that its devotees have their own fashionable malady. Cubist's thumb has definitely replaced tennis elbow. So, in an endeavor to preserve the national health we have offered two cube simulation programs (one for the Apple and one for Z-80 systems) in this issue. But both programs only offer one mode of what we feel should be included in a *complete* cube program. The Coopers' and Paul Turvill's programs allow you to input a desired number of twists, which the computer then makes; then it is up to you to restore the cube. That's a fine first step. In fact, it is just like working with an actual Rubik's Cube. The next step would be to include a sec-

ond mode in which you would mix up the cube and the computer would restore it. Such programs do exist—I have seen a few excellent ones for large computers and heard of a few for micros. In fact, we are in the process of reviewing a few for possible publication and would be interested in seeing more.

Micros and Minis

Last spring a somewhat unsettling situation came to my attention. A friend who had just earned his degree in computer science from a large state university and I were talking about job prospects in the computer field. He was concerned because, in spite of a good academic record, he was having some difficulty in finding a good position. He said that he was interested in gaining some programming experience and was especially interested in working with Pascal.

I couldn't understand why he was having any trouble at all finding a good job. We are constantly hearing about the need for good programmers. I asked what companies he had been talking to. He named several of the large minicomputer manufacturers and several companies that offer software support services for the products of these manufacturers. When I asked what microcomputer companies and software houses he had contacted, his answer astonished me, especially in light of the fact that he wanted to locate in the San Francisco area. He hadn't been in contact with any.

As we talked it became apparent that he was equating microcomputers with video games. He didn't think of micros as real computers. And worst of all he was completely unaware of the extremely large and rapidly growing microcomputer industry. He simply did not know it existed. It was disturbing to find that a good student could complete four years in a respected computer science program and never be made aware of one of the most dynamic segments of the computer industry. After doing some checking I found that my young friend's situation was not uncommon. I also learned of several educational institutions that do incorporate microcomputing into their programs. These schools are working to give their students a full picture of the field for which their graduates are being prepared. But there are still a number of highly re-

spected schools that are not offering their students a complete preparation for their chosen field.

Several possible reasons for this exist, but two of them seem to stand out. The microcomputer field, as we all know but sometimes forget, is very new—by most accounts only about six years old. As a significant industry, microcomputing is even newer. And most computer science professors were trained during, or were part of, the minicomputer revolution. Then too, educational institutions are not always noted for their ability to rapidly change with the times, despite the best efforts of some of the faculty. (We have to sympathize with those who must try to convince an administration that is still paying for a large time-sharing system to go out and buy a significant number of new machines—but we have learned of some very creative strategies used by some individuals and departments to get around this obstacle for the benefit of their students.)

It still bothered me that a number of young computer professionals would have to gain their first microcomputing experience as on-the-job training. Feeling, however, that the computer-educational establishment was at least starting to move in the proper direction, I more or less put the mini/micro question out of my mind. But a recent article in a computer publication (see "Mini or Micro: Which Way to Go?" by John Seaman in *Computer Decisions*, Oct. 1981, p. 90) raised the question anew in a slightly different context. Here the question was posed in the context of which kind of system was most appropriate for business purposes. (It may be a bit unfair to single out Seaman's article, because one can find numerous articles containing some of the same information and I believe Seaman was trying to be objective. The information he was dealing with, however, made that impossible.)

The criteria for comparison in this article are:

- speed of operation
- response time
- amount of memory
- control of a variety of peripherals
- hardware and software availability
- service

(continued on page 93)

Uncovering the History Of the Earth

By Fred J. Gunther

Computers have contributed to important changes in the way scientists do science. Some advances, such as those in space research, are enormous and obvious; others are not. But the way data is collected, organized and analyzed has unquestionably changed in all branches of science, and microcomputers are the

newest part of that change.

Most geologists are not mathematically or computer oriented. They are interested in the Earth, its rocks and minerals, its parade of plant and animal life through geologic time, its mountains and what caused them and its oceans and continents.

Even geologic research has

changed because of the use of computers. Earthquake data is recorded with much greater sensitivity. Indications of ore deposits can be detected in computer-processed images taken by satellites. Several technical journals publish articles by mathematical geologists concerning fossils, magnetism, ore deposits, storm waves and statistical tests. Data of all types can be processed much more efficiently and accurately.

When I was a graduate student, my first job as a laboratory assistant was to help a senior graduate student with his research. I was to take his hand-calculated results for species percent data at each of many oceanographic collection stations and calculate an index of similarity for each and every pair of stations. The resulting numbers would enable the senior graduate student to draw a map of the ocean floor showing which stations had similar collections of animals. There were many stations, and many species, and it took weeks to calculate the matrix.

That same semester, I took a course in FORTRAN IV computer programming on a CDC-3300 (a big computer in 1967). By the time I was a senior graduate student, I had designed, written and debugged a computer

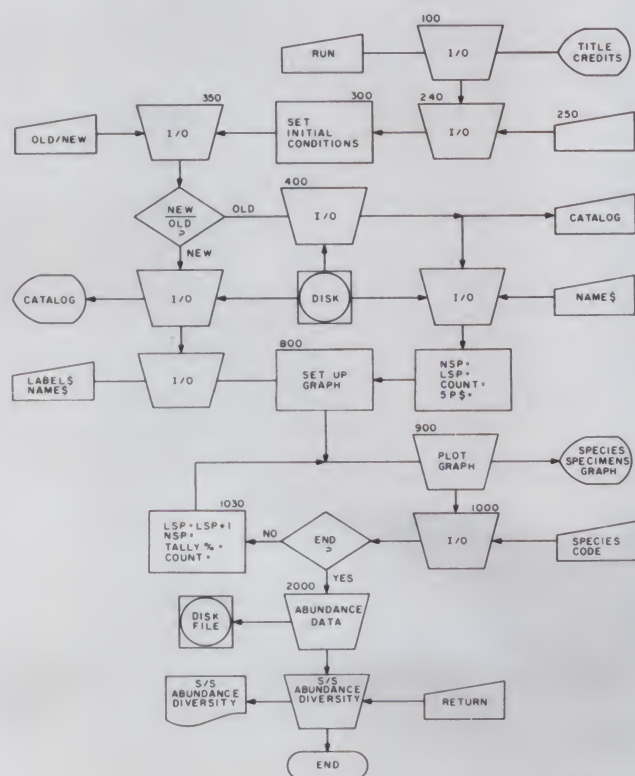


Fig. 1. Flowchart for the PEG Helper program.

Address correspondence to Dr. Fred J. Gunther, 9464 Wandering Way, Columbia, MD 21045.

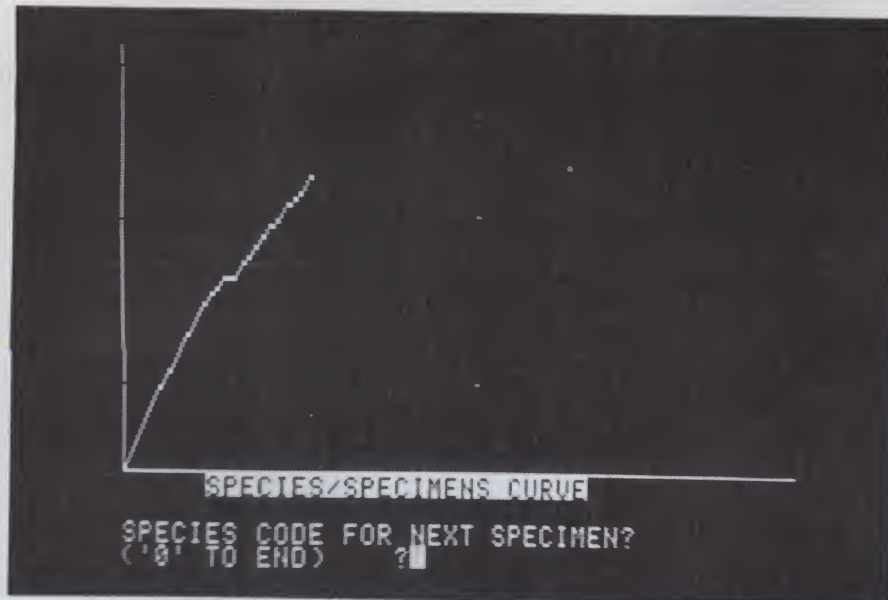


Photo 1. Monitor display of Example Species/Specimens curve. The steepness of the curve indicates that new species are still being found at a rapid rate. For this reason many more specimens need to be examined to adequately know what the species composition of the sample is.

program that calculated the same index of similarity for all station pairs in a few seconds. In addition, it produced all of the other previously hand-calculated values for species abundance. And it calculated many other "nifty numbers" of use and interest to geologists and marine biologists.

Input Problems

To use my program, I still had to examine the samples, keep a tally of the number of specimens for each sample and keypunch the data onto computer cards.

Many other scientists face the same problems in data entry. Marine biolo-

gists often count the numbers of individuals for each species of plant or animal. Ecologists often pay close attention to both the type and the number of specimens for each species. Many scientific studies depend upon being able to tally the number of specimens for each species. The frequency distributions of species in each sample can be compared by eye or by computer program to indicate what the natural communities or groups of species are.

Some solutions to the data-entry problem have been suggested. The counted number of specimens can be entered onto a machine-readable form. The sense-marked form or card

can then be read by a computer in essentially the same way as for machine grading of multiple-choice examinations.

Data entry directly from sample material has been performed using large computers for automatic shape analysis, but only for special cases in medicine and genetics. Recently a microprocessor-based texture analysis station for cell and tissue samples, featuring direct data entry, has been advertised.

Fossils, however, must be identified by eye. Direct-entry computer systems cannot handle the variety in shapes and orientation encountered in the species-analysis of paleontologic, ecologic or geologic samples. Fossil specimens must be found, separated from the surrounding rock, cleaned, examined and finally identified and tallied by species.

I decided to use an Apple microcomputer to keep the tally for each species in a sample. The program presented here (Listing 1) allows the Apple to assist the scientist or technician in data collection and preliminary analysis. It's named the PEG Helper because I use it for research in

SP\$(100)	The array of species ID codes. A string variable is used so that numbers and/or letters can form the ID code. Thus 33 is as valid as T33, and both are as valid as the full scientific name, <i>Textularia earlandi</i> . Be careful of spelling errors on input; each spelling variation is treated as a different species ID code.
COUNT(100)	The array of the counted number of specimens for each species. It is updated every time a new specimen ID code is entered.
TALLY%(1000)	The array for the number of species known at the time that each specimen was found. It is updated every time a new specimen ID code is entered.
NSP	The total number of species. It is updated each time a new species is entered.
LSP	The total number of specimens. It is updated every time a specimen ID code is entered.
LABEL\$	A string variable with sample and project identification information. It is typed in by the analyst at the start of an analysis. It is stored on the disk to be read when an analysis is continued after an interruption.
NAME\$	A string variable for the name of the data file. It is used for disk storage and must be unique.

Table 1. Important variables for PEG Microscope Helper program.

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Microcomputing, January 1982 61

Paleontology, Ecology and Geology. All I have to do is type in a code name or number each time I see a specimen. The computer does all the rest of the data entry, record-keeping and calculations. The program helps me to "work smart, not hard."

Bells and Whistles

Of course, once the data is in

machine-readable form, other things can be done (Fig. 1). The program does much more than simply replace a tally sheet or a multi-key counter. A variety of important reports are produced from the data.

The program calculates the relative (percent) abundance of each species and prints this along with the tally and species ID code. (Sample 1.)

A graph showing the frequency of occurrence of new species as additional specimens are studied is a very useful report. Where the curve is steep, the analyst can expect to find more species as more specimens are examined. Where the curve is very flat, the analyst can expect that the examination of additional specimens is unlikely to produce additional species. The curve therefore can be used to predict the results of additional work to analyze the sample. If the curve is very flat, the cost of finding new species may be considered to be too high, and the analyst can stop.

A manual tally of the number of specimens vs the number of species is very difficult to keep. I've done it many times and know the problems involved well. The program instructions allow the computer to keep the tally and to generate a continuously-updated plot for every single sample, at no extra effort to the analyst (Photo 1).

Species diversity is one of those "nifty numbers" mentioned earlier. It is of interest to specialists in the studies of modern and ancient groups of animals or plants. It attempts to measure one aspect of population or group organization. Changes in diversity have been related to changes in the environment in many scientific studies; it is common knowledge that there are fewer species and in-

Sample 1. Printer copy of Species Abundance matrix. This is the data that would have to be tallied by hand and entered to a computer by punched cards if this program did not exist. This data is stored on a disk file for direct entry to computer programs that will do additional analyses.

SPECIMEN COUNT	SAMPLE PERCENT	SPECIES ID CODE			
1	1.28205128	28	2	2.56410256	26
2	2.56410256	70	1	1.28205128	52
2	2.56410256	43	1	1.28205128	41
2	2.56410256	67	1	1.28205128	54
1	1.28205128	30	1	1.28205128	3
1	1.28205128	24	1	1.28205128	44
1	1.28205128	68	2	2.56410256	72
1	1.28205128	4	1	1.28205128	37
1	1.28205128	49	1	1.28205128	86
2	2.56410256	27	1	1.28205128	59
1	1.28205128	74	1	1.28205128	92
1	1.28205128	75	1	1.28205128	23
1	1.28205128	61	1	1.28205128	50
2	2.56410256	8	1	1.28205128	89
5	6.41025641	69	1	1.28205128	29
2	2.56410256	25	1	1.28205128	32
2	2.56410256	13			
3	3.84615385	39			
2	2.56410256	5			
1	1.28205128	16			
2	2.56410256	7			
1	1.28205128	35			
1	1.28205128	99			
3	3.84615385	79			
2	2.56410256	47			
1	1.28205128	97			
2	2.56410256	73			
1	1.28205128	40			
2	2.56410256	57			
1	1.28205128	22			
1	1.28205128	62			
2	2.56410256	42			
1	1.28205128	2			
1	1.28205128	58			
1	1.28205128	96			
1	1.28205128	17			
1	1.28205128	84			
1	1.28205128	98			
1	1.28205128	82			

DIVERSITY INDICES

55 = NUMBER OF SPECIES

12.3946773 = MARGALEF'S INDEX

.976988823 = SIMPSON'S INDEX

-10.8321596 = MC INTOSH'S INDEX

1.6948065 = SHANNON'S INDEX (INFORMATION THEORY)

REFERENCES

MAC ARTHUR 1965 BIOL.REVIEW 40:511-533
MC INTOSH 1967 ECOLOGY 48(3): 392-404
SANDERS 1968 AMERICAN NATURALIST 102(925): 243-282

Sample 2. Printer copy of diversity data.

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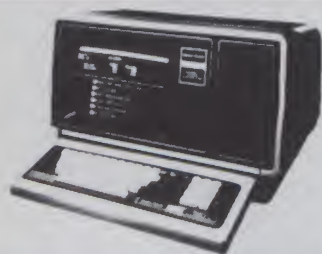
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dividuals in Arctic regions than in tropical regions.

Many scientists have calculated the species diversity of the samples that they study. Of course, where there are many people, there are many different opinions. There are several opinions on how to measure the diversity of a sample, and so there are several algorithms. Each tries to answer the question, "Is this sample really different from that sample?"

The Helper program helps out in this case also. It calculates and prints several indices of diversity. The printer copy (Sample 1) with the different diversity values becomes part of the analysis file for the sample and project.

Program Code

The program code has three major sections (see Fig. 1). The program

first prints a title page and asks the user for information (Photo 2); it then sets up the initial conditions for that run (Listing 1, lines 90 to 950). Second, the program requests input for each species, and then processes the data (Listing 1, lines 900 to 1090—yes, lines 900 to 950 are used by both setup and run portions of the program). Finally, when the input sequence is complete, the program writes the data onto a disk file (Listing 1, lines 2000 to 2170), and prints (lines 3000 to 5430) a hard copy of the results (Fig. 2 and Sample 1; also Sample 2). The program is so dependent upon user input for pacing that it is coded in linear (non-optimized) form (see Fig. 1 and Listing 1).

Program Use

I have already written a lot about how the program is used. However,

Listing 1. PEG Microscope Helper, written in Applesoft BASIC to take advantage of high-resolution graphics to display the species/specimens curve.

```

90 CLEAR
100 HOME : PRINT "      P E G      MICROSCOPE HELPER"
110 PRINT : INVERSE : PRINT "P", : NORMAL : PRINT "PALEONTOLOGY"
120 INVERSE : PRINT "E", : NORMAL : PRINT "ECOLOGY"
130 INVERSE : PRINT "G", : NORMAL : PRINT "GEOLOGY"
140 PRINT : PRINT : INVERSE : PRINT "DR. FRED J. GUNTHER"
150 PRINT "9464 WANDERING WAY": PRINT "COLUMBIA MD 21045"
160 NORMAL : PRINT : PRINT : PRINT "INPUT IS ID CODE FOR EACH SPECIMEN"
170 PRINT : PRINT : PRINT "OUTPUT IS:"
180 LET MM$ = "SPECIES/SPECIMENS CURVE"
190 PRINT "  -1- HGR":MM$
200 PRINT "  -2- DISK COPY, SPECIES TALLY"
210 PRINT "  -3- PRINTED ":MM$
220 PRINT "  -4- PRINTED SPECIES TALLY"
230 PRINT "  -5- PRINTED SPECIES DIVERSITY": PRINT : PRINT
240 LET M$ = "ADJUST PRINTER AND (RETURN)"
250 PRINT M$: INPUT "SLOT NUMBER FOR PRINTER ":N
260 PRINT : INPUT "SPECIAL PRINTER CONTROL CHARACTERS. ":CC$
300 HOME : REM SET INITIAL CONDITIONS
310 VTAB 10
320 DIM SP$(100),COUNT(100): REM UP TO 100 SPECIES
330 DIM TALLY$(1000): REM UP TO 1000 SPECIMENS
340 LET NSP = 0:LSP = 0
350 INPUT "NEW SAMPLE OR CONTINUATION OF OLD?      (NEW/OLD) ":IN$
360 IF IN$ = "NEW" THEN GOTO 600
370 IF IN$ = "OLD" THEN GOTO 400
380 PRINT : INVERSE : PRINT "UNEXPECTED RESPONSE"
390 NORMAL : PRINT : GOTO 350
400 HOME : PRINT "WHICH FILE? ('O' IF NOT HERE)"
410 PRINT : PRINT CHR$(4);" CATALOG"
420 PRINT : INPUT NAME$
430 IF NAME$ = "O" THEN PRINT "INSERT NEW DISK": GOTO 350
440 PRINT CHR$(4);" OPEN ":NAME$
450 PRINT CHR$(4);" READ ":NAME$
460 INPUT LABEL$: INPUT NSP: INPUT LSP
470 FOR J = 1 TO NSP: INPUT COUNT(J)
480 INPUT SP$(J): NEXT J
490 PRINT CHR$(4);" CLOSE ":NAME$
500 GOTO 800
600 PRINT "TYPE IN LABEL FOR THIS SAMPLE."
620 PRINT : INPUT LABEL$: PRINT : PRINT
630 PRINT "IS THIS THE DISK YOU WANT TO STORE THE"
640 PRINT "DATA ON?": PRINT CHR$(4);"CATALOG"
650 INPUT "(YES/NO)":IN$: IF IN$ = "YES" THEN GOTO 670
660 INPUT "PUT PROPER DISK IN DRIVE AND (RETURN)":IN$: GOTO 630
670 PRINT : INPUT "GIVE FILE NAME (DO NOT USE ONE OF THE ABOVE).":NAME$
800 REM SETUP HGR GRAPH
810 HOME : VTAB 21: HGR : HCOLOR= 3
820 HPLLOT 0,0 TO 0,159 TO 279,159
830 PRINT ".....": INVERSE : PRINT MM$
840 NORMAL : POKE 34,23: VTAB 23
900 LET Y = 159 - 2 * NSP
910 IF Y < 0 THEN GOTO 1000

```


some details might be useful to you to see if you could use it in your applications.

The program has been used in a computer with the keyboard next to a microscope (for small fossils) or specimen-sorting tray (for large fossils) in a laboratory. The computer must be connected to a monitor, a disk drive and a printer.

The analyst first enters general sample information, starting a new file or continuing an old one as appropriate. S/he spreads the sample thinly over the surface of a small tray and carefully searches it for specimens. Usually, there are many grains of sand and few specimens. As each specimen is encountered, the analyst identifies it and types a short code name or number on the keyboard. A specimen that is new to the project must be given a new code ID and set

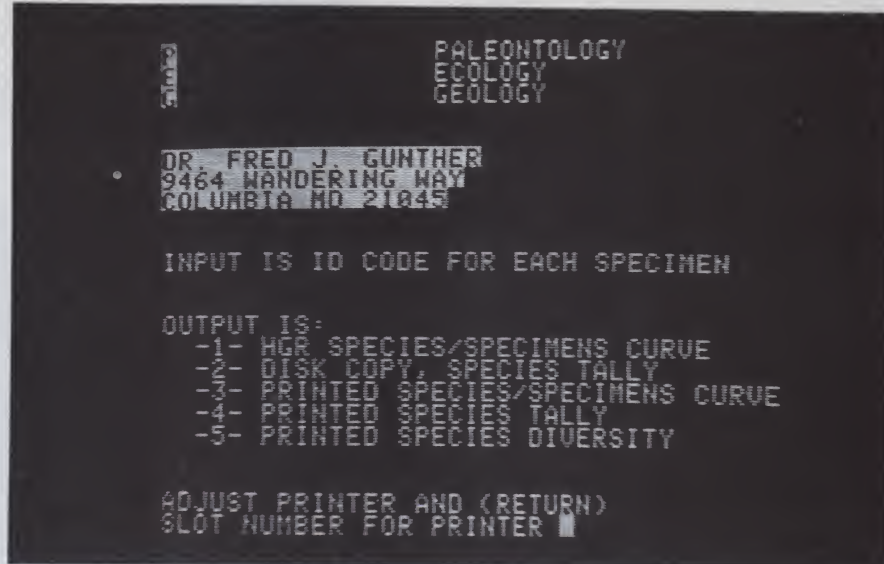


Photo 2. Monitor display of program title page. The prompt at the bottom of the page allows the program to be run on systems with different configurations.

```

920 LET J = LSP
930 IF J > 280 THEN LET J = J - 280: GOTO 930
950 HPLLOT J,Y TO J,Y + 1
1000 PRINT "SPECIES CODE FOR NEXT SPECIMEN?"
1010 PRINT " ('O' TO END)",
1020 INPUT IN$: IF IN$ = "O" THEN TEXT : POKE 34,0: GOTO 2000
1030 LET LSP = LSP + 1
1035 FOR J = 1 TO NSP:JJ = J
1040 IF IN$ = SP$(J) THEN GOTO 1070
1050 NEXT J:NSP = NSP + 1: REM ADD NEW SPECIES
1060 LET SP$(NSP) = IN$:JJ = NSP: REM STORE NEW SPECIES WORKING CODE
1070 LET TALLY$(LSP) = NSP
1080 LET COUNT(JJ) = COUNT(JJ) + 1: REM UPDATE SPECIES ABUNDANCE MATRIX
1090 GOTO 900
2000 PRINT "WRITE DATA TO DISK FILE."
2110 PRINT CHR$(4);"OPEN";NAME$: REM WRITE DATA TO DISK
2120 PRINT CHR$(4);"WRITE";NAME$
2130 PRINT LABEL$: REM KEEP ID WITH FILE
2140 PRINT NSP: REM NUMBER OF SPECIES
2150 PRINT LSP: REM NUMBER OF SPECIMENS
2160 FOR J = 1 TO NSP: PRINT COUNT(J): PRINT SP$(J): NEXT
2170 PRINT CHR$(4);"CLOSE";NAME$
3000 TEXT : FLASH : PRINT M$: INPUT IN$: NORMAL
3110 PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT MM$: PRINT
3120 PRINT ",0": FOR J = 10 TO 100 STEP 10: PRINT " ";J: NEXT J: PRINT
3130 PRINT ",*": FOR J = 1 TO 10: PRINT "----I----*": NEXT : PRINT
3140 FOR J = 1 TO LSP: PRINT J,"*": REM PRINT A LINE
3150 IF TALLY$(J) = 1 THEN PRINT "#": GOTO 3170
3160 FOR JJ = 2 TO TALLY$(J): PRINT " "; NEXT JJ: PRINT "#"
3170 NEXT J
4000 FOR J = 1 TO 5: PRINT : NEXT : REM ABUNDANCE DATA
4100 PR# O: PRINT M$: INPUT IN$
4110 PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT
4120 PRINT "SPECIMEN","SAMPLE","SPECIES":PRINT "COUNT","PERCENT","IDCODE"
4130 FOR J = 1 TO NS: PRINT COUNT(J),100 * COUNT(J) / LSP,SP$(J): PRINT : NEXT
5000 PR# O: PRINT M$: INPUT IN$
5010 PR# N: PRINT CC$: PRINT LABEL$: PRINT : PRINT
5020 PRINT "","DIVERSITY INDICES": PRINT : PRINT
5030 LET SSQ = 0:PSQ = 0:PLG = 0
5040 PRINT NSP;"=NUMBER OF SPECIES"
5100 FOR J = 1 TO NSP: LET P = COUNT(J) / LSP
5110 LET SSQ = SSQ + COUNT(J) ^ 2
5120 LET PSQ = PSQ + P ^ 2
5130 LET PLG = PLG + P * LOG (P) * 0.4342945
5140 NEXT J
5200 LET DM = (NSP - 1) / LOG (LSP)
5210 LET DH = - 1 * PLG
5220 LET DD = 1 - SQR (SSQ):DP = 1 - PSQ
5300 PRINT : PRINT : PRINT DM;"=MARGALEF'S INDEX"
5310 PRINT : PRINT : PRINT DP;"=SIMPSON'S INDEX"
5320 PRINT : PRINT : PRINT DD;"=MCINTOSH'S INDEX"
5340 PRINT : PRINT : PRINT DH;"=SHANNON'S INDEX (INFORMATION THEORY)"
5400 PRINT : PRINT : PRINT "","REFERENCES": PRINT
5410 PRINT "MACARTHUR 1965 BIOL. REVIEW 40:511-533"
5420 PRINT "MCINTOSH 1967 ECOLOGY 48(3): 392-404"
5430 PRINT "SANDERS 1968 AMERICAN NATURALIST 102(925): 243-282"
6000 PR# O: POKE 34,0: END

```


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aside for later identification; specimens of recognized species need not be set aside.

All records are kept by the computer. It is not necessary for the analyst to write down anything, other than the ID code for each set-aside specimen. The computer keeps all data up-to-date on internal files. It also plots in real time the species/specimens curve. At the end of the analysis, the computer prints disk copies of some files and hard copies of all files.

Because the analysis of a sample may take a long time, the program has the capability of reading a disk file. This allows the analyst to take a break (for coffee, lunch, or the end of the working day) after recording the data up to that time. The analyst can continue from that point after the program has read the stored data from the disk file. The computer

printout for that sample will be in two or more parts, but that problem can be solved with scissors and tape.

The program should be useful not only to paleontologists (geologists who work with plant and animal fossils), but also to many other scientists and to anyone interested in the numbers of species of plants or animals found in one place. Even those who work with inorganic items, such as geologists who study sand grains, could find this program useful in collecting data about the "species" of heavy minerals. It might even be useful to a traffic analyst, who must count the numbers of different types of vehicles that pass a certain point of a road. It could assist in keeping track of the numbers and species of birds that visit a bird feeder, or the animals that visit a salt lick or a water hole. Let me know what uses you have found for the program. ■

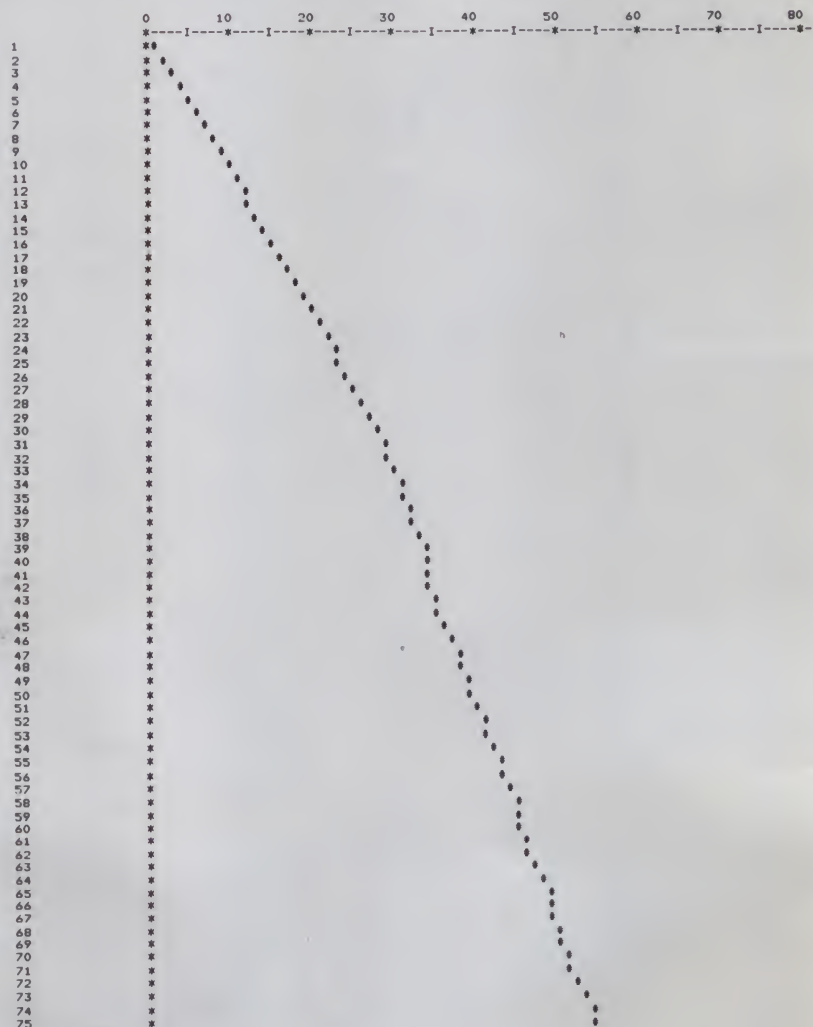


Fig. 2. Printer copy of Example Species/Specimens curve. The number of species is printed horizontally and the number of specimens vertically. Each specimen is represented by a line; if a specimen is of a new species, a new column is added. This is the same curve shown in Photo 1, but this curve is produced using a different medium with a different aspect ratio to the plot.

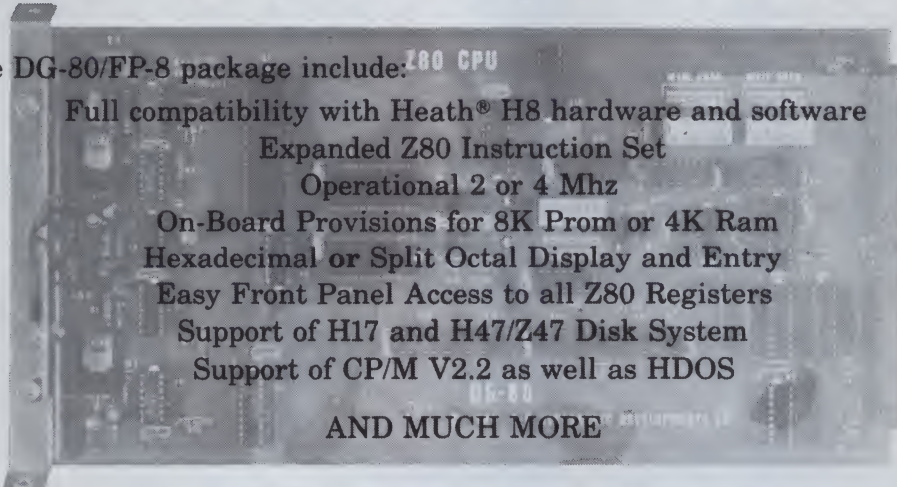
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Red Hot Computing

By Paul T. Ward

Many laboratory phenomena require recording a rapidly changing dc voltage for later analysis. In my laboratory, I routinely measure the output of photomultiplier tubes, recording the glow of irradi-

ated phosphors as they are heated. During the heating process, the phosphors give off varying amounts of light, depending on the type of radiation and the temperature.

In the past, this glow curve has

been recorded on a fast chart recorder. This became less accurate as we increased the heating rate, due to the starting inertia of the paper and pen.

The next step was to use an oscilloscope with a Polaroid camera to eliminate the mechanical time lags. This works, but it is less than ideal due to the high cost, the small size of the picture and the tricky synchronization problem. The synchronization problem can be solved with a special storage screen oscilloscope, but this is very expensive and tends to smear the recording.

I needed a good, low-cost method of recording graphic data that's too fast for a conventional chart recorder and too slow for a normal oscilloscope.

The answer was to bring in my Apple II microcomputer and hook it up to the photometer in the lab through an analog-to-digital (A/D) converter. I used an Interactive Structures AI-02 converter, which is an eight-bit, 16-channel model. This device accepts dc voltages from 0-5 V, and digitizes this into a number from 0-255.

The digitization is started by poking a base address (which depends on the slot number of the converter) with the number of the A/D channel



From left to right, IDS-440 Paper Tiger printer, Panasonic model UD702 thermoluminescent dosimeter reader, Apple II+, chart recorder and Tektronix oscilloscope with Polaroid camera attached.

Program listing.

```
10 REM A/D CONVERTER PROGRAM FOR
20 REM INTERACTIVE STRUCTURE
30 REM MODEL AI-02 ANALG-DGTL CONVTR
40 REM A=BASE ADDRESS
50 REM AP1=CONVERSION RESULT ADDRESS
60 REM CH=CHANNEL # OF A/D CONVERTER
70 REM V(I)= RESULT OF CONVRSN I
75 REM P(I)= V(I) * SCALE FACTOR TO PLOT ON HI-RES PAGE ONE
80 REM
82 D$ = CHR$(4)
```

More →

Address correspondence to Paul T. Ward, Radiological Health program, School of Public Health, The University of Michigan, Ann Arbor, MI 48109.

connected. You get the result of the conversion by peeking at an address one byte higher than the base address.

By using the Program listing, I obtained a plot of the digitized data just like one from our storage screen oscilloscope running at 1 cm/sec. The data was plotted in high-resolution graphics as it was generated. If you need faster sampling rates, the plotting could be done later, since the values are stored in the V array.

An option at the end of the program stores the data as numbers, a high-resolution picture or both. To restore the picture to the screen, first BLOAD the file it was saved in, then enter

GR:POKE - 16297,0

to restore the high-resolution screen. The screen image can be hard-copied on a dot-matrix printer with a graphics driver program. A short BASIC program is required to read the number data from the disk file.

Similarly, you can make a fast X-Y recorder by plotting one conversion against the other, recording from two A/D channels alternately. This technique is useful for examining the hysteresis loop of control systems too fast for conventional X-Y recorders. ■

Listing continued.

```

85 DIM Q$(5),NM$(15)
90 DIM V(280),P(280)
95 HGR : TEXT
100 A = 14592: REM SLOT #7 ADDRESS
110 AP1 = A + 1
120 CH = 0: REM CHANNEL ZERO
130 CALL - 936: VTAB 10: PRINT "THIS PROGRAM READS A D.C. VOLTAGE FROM
"
140 PRINT : PRINT "0 TO 15.0 VDC USING AN INTERACTIVE"
150 PRINT : PRINT "STRUCTURES MODEL AI-02 A/D CONVERTER"
160 REM START CONVERSION
170 VTAB 23: PRINT "PRESS ANY KEY TO CONTINUE"
180 IF PEEK ( - 16384 ) > 127 THEN GOTO 200
190 GOTO 180
200 CALL - 936: VTAB 23: PRINT "RECORDING DATA "
210 HGR : HCOLOR= 3: HPLOT 0,0 TO 0,159: HPLOT 0,159 TO 279,159
220 FOR I = 0 TO 279
230 POKE AP1,CH
240 V(I) = PEEK (A)
250 P(I) = V(I) * 0.623: REM SCALE DATA TO FIT HI-RES PAGE ONE
260 HPLOT I,(159 - P(I))
270 NEXT I
280 CALL - 936: VTAB 23: PRINT "RECORDING FINISHED "
290 PRINT : INPUT "SAVE THIS DATA? ";Q$
300 IF LEFT$(Q$,1) = "Y" THEN GOTO 350
310 PRINT : INPUT "ANOTHER RUN? ";Q$
320 IF LEFT$(Q$,1) = "Y" THEN GOTO 170
330 END
350 PRINT "WHAT FILENAME? (UP TO TEN CHARACTERS)": INPUT NM$
360 INPUT "SAVE PICTURE TOO? ";PC$
370 PRINT D$;"OPEN";NM$
375 PRINT D$;"WRITE";NM$
380 FOR K = 0 TO 279
390 PRINT V(K)
395 NEXT K
400 PRINT D$;"CLOSE";NM$
420 IF LEFT$(PC$,1) = "Y" THEN GOTO 450
430 GOTO 310
450 NM$ = NM$ + ".PIC"
470 PRINT D$;"BSAVE ";NM$;"A$2000,L$2000"
490 GOTO 310

```

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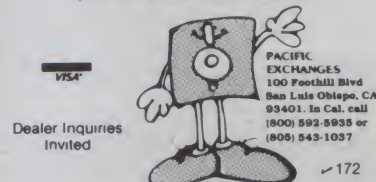
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Tapping Into the Brain

By Robert M. Bradley

Of all the organs in the body, the brain is perhaps the least understood. It is the last frontier of biology.

Neurophysiologists have been able to gather much information on brain function by recording activity from the peripheral and central nervous systems and analyzing the resulting records. Until recently, this has been a tedious chore—investigators have had to rely on measurements from recordings photographed on a moving film passing across an oscilloscope screen. But the digital computer makes possible many types of analysis not possible before.

This interface for the Heath H8

measures the intervals between neural discharges and stores the data on disks for later study. It also stores in the data stream a marker to indicate the beginning and end of a stimulation. Once the interval data is stored, software can be used to convert intervals into frequency of impulses, and show the distribution pattern of the intervals with respect to time. The extent of the analysis is dependent primarily on the imagination and ingenuity of the researcher.

About Neurons

Neurophysiologists record electrical impulses produced by neurons. A

neuron, the basic building block of the central nervous system, is made up of a cell body with cytoplasmic extensions called axons and dendrites. A neuron usually has only one axon, but can have a number of dendrites.

All information travelling in the central nervous system passes along the axons to the dendrites, where it crosses a synapse to the axon of the next neuron in the chain. Thus, neural activity typically begins at a sense organ and is transmitted along the neurons to the central nervous system, where the information is processed. This processing can result in a number of actions, the most obvious involving muscle use.

Neurophysiologists are particularly interested in the functioning of sensory receptors, specialized dendrites sensitive to physical states. A series of these receptors senses the external environment and translates the information into signals used by the central nervous system.

For example, the retina converts light energy into neural energy. The neural energy consists of action potentials (spikes, neural discharges) that are sent along the neurons to the central nervous system. These action potentials are a coded message of the transduced external energy.

To understand how the brain works, the researcher must tap into the neural messages and decipher the

Listing 1. Assembly-language listing of the program designed to run with the interface.

```
+INTERSPIKE INTERNAL PROGRAM-ISIS-
+
+AUTHOR: ROBERT M. BRADLEY
+      DEPT. ORAL BIOLOGY
+      SCHOOL OF DENTISTRY
+      UNIVERSITY OF MICHIGAN
+      ANN ARBOR
+      MICHIGAN, 48109.
+*****
+PULSE IS ON D0 PORT 004
+MARK BIT IS D1 PORT 004
+STOP BIT IS D2 PORT 004
+RESET IS PORT 006
+LSBYTE OF INT COUNT IS PORT 000
+MSBYTE OF INT COUNT IS PORT 002
+CLOCK IS SET AT 1MSEC
+MAXIMUM INTERVAL STORAGE 2KBYTES
+-----+-----+
+TEXT      HDOS
+START     ORG      USERFWA
+MODE      EQU      2230 +SPECIFIES PORTS A & B OF 8255 AS INPUT PORTS.
+CNTRL     EQU      0030 +AND PORT C AS 2 4 BIT PORTS, 1 AS INPUT 1 AS OUTPUT
+DATA1     EQU      0000 +LSBYTE OF COUNT PORT
+DATA2     EQU      0010 +MSBYTE OF COUNT PORT
+DATA3     EQU      0020 +PULSE MARK AND STOP BIT PORT
+.OPENM    EQU      000043A +HDS DEFINITIONS
+.WRITE    EQU      000005A + " "
+.CLOSE    EQU      000046A + " "
+BEGIN     XRA      A
+          MVI      B,0010
+          MVI      C,2010
+          SCALL    .CONSL +SET UP TERM
+          MVI      A,MODE +SET UP 8255
+          OUT      CNTRL + SETS UP TRANSFER CHARACTERISTICS
+
+          GET OUTPUT FILE NAME
```

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neural code. This is analogous to using a logic tester in a computer circuit.

To do this, he must isolate single neurons and record their action potentials, while stimulating the receptors to which they are connected. This is done either by dissecting the peripheral nerves to isolate single axons, or advancing an electrode with a very small uninsulated tip into the brain or other parts of the central nervous system. In either case, an active electrode picks up the electrical activity of the isolated neuron, while an indifferent electrode placed in nearby tissue completes the circuit.

The neural activity is amplified and recorded on magnetic tape. After the experiment, the tape is replayed and the data is analyzed.

The recordings consist of a series of action potentials that occur at various intervals. An example of a small portion of such a recording is shown in Fig. 1. Note that the neural discharges are essentially a digital code. The action potentials from one neuron are of fixed magnitude, and last about 1 ms. The analog recording is then passed through a window discriminator, which converts the action potentials into standard TTL pulses. The neural data is now in the form that can be analyzed by a digital computer.

Since action potentials from one neuron are of a fixed magnitude, the neural code cannot be in the form of amplitude modulation, but rather must rely on frequency modulation. All the information relating to the magnitude and quality of the stimulus must be contained in a frequency-modulated code. For example, the neural discharge pattern from a single fiber connected to a taste bud must convey not only information on the concentration of the stimulus but also on what kind of chemical has been applied to the tongue (e.g., salty, sour, bitter, sweet-tasting).

Hardware

A block diagram of the interface is shown in Fig. 2 and a full schematic in Fig. 3. A crystal-controlled clock is set at a frequency of 1 kHz to give a pulse every 1 ms. These pulses are counted by a 16-bit binary counter. The least-significant byte of this count goes to one eight-bit input port, and the most-significant byte to a second port. One bit of an output port is used to reset the counter. A third port is used for input from the data pulses as well as the mark (stimulus beginning and end) and end analysis pulses.

Since a 16-bit counter is used, 65,536 ms is the maximum interval that can be counted, which is more than sufficient for most neural data. The interface functions therefore in a very straightforward manner.

The computer first resets the counters, and then looks at the pulse mark and end port. When it meets a data pulse, the computer gets the input from the binary counters, resets the counters and looks for the next pulse. Whenever the mark bit is set, the computer then stores the next series of intervals in a second storage location. The reset pulse now not only resets the counters but also the mark bit.

The same series of events takes place when the mark pulse is set again (end of stimulation period). Finally after the poststimulus period the end bit is set and data analysis is finished. If the mark facility is not required, both the hardware and software become much simpler to design. Often, however, the time of stimulus onset can be very accurately determined and recorded on a second channel of the analog recording during the experiment. On playback, the stimulus marker channel can be used to control the mark input bit.

The schematic diagram is, for the most part, self-explanatory. The three input ports are neatly implemented using an 8255 programmable peripheral interface integrated circuit (see P. F. Goldsborough's *Microcomputer Interfacing with the 8255 PPI Chip*). One of the ports is split into a four-bit

input and four-bit output port.

I ran into a problem in the early design stages: the computer could store the interval data in a shorter time than the length of the data pulse. It therefore appeared to the computer as if a further input pulse was present when in fact it was not. To get around this problem, I used a "one and only one synchronizer" described in Don Lancaster's *TTL Cookbook*.

The incoming data pulse is used to gate a 1 μ s clock pulse, which is used to set a flip-flop. Thus, the data pulse is converted to a pulse that the computer can reset once the interval has been stored. In effect, the incoming pulse is held until the computer acknowledges its presence. The use of this circuit gives very accurate interval measures.

The same type of circuit is used for the mark input pulse. The rest of the circuitry consists of address decod-

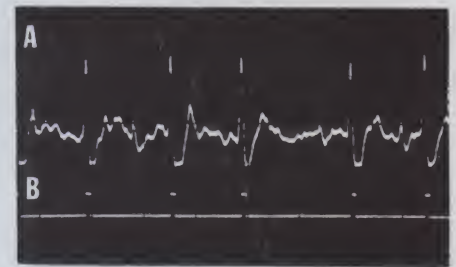


Fig. 1. a) Oscilloscope tracing of action potentials recorded from the chorda tympani nerve in a rat. b) TTL output pulses produced when the action potentials of 1a are passed through a window discriminator.

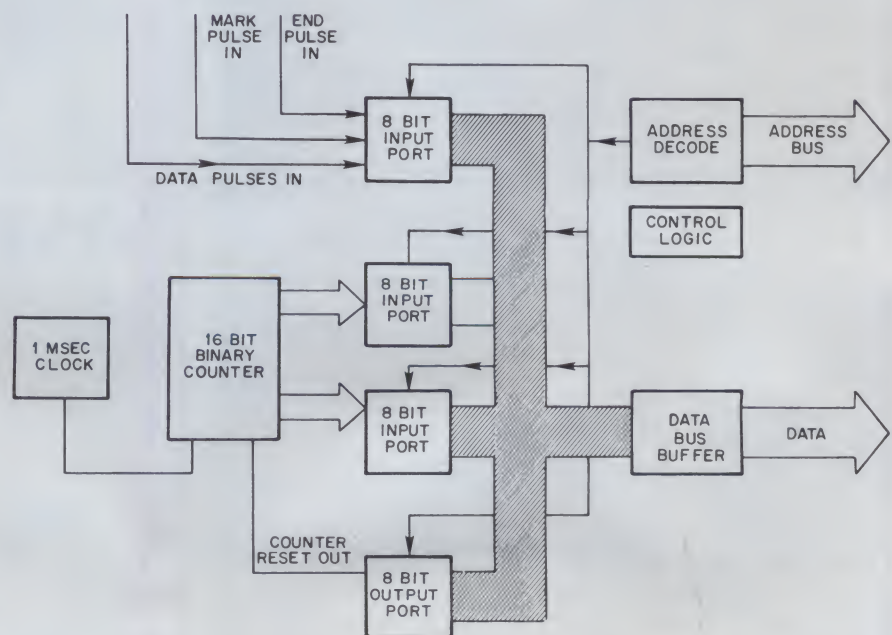


Fig. 2. Block diagram of an interface designed to measure the intervals between neural impulses.

ers, input control logic and switch de-bounce logic. For this application, the mark and end bits are set by momentary push-buttons. As I mentioned before, this could easily be done by using pulses recorded on magnetic tape during the experiment.

Software

I originally wrote the software in BASIC, which was far too slow for the speed of the neurophysiological data. The software listing of Fig. 4 is therefore in assembly language. A BASIC program analyzes the interval data stored on disk. (I haven't included mine here, since the program must be suited to individual needs.) Besides the fact that speed is not critical here, it would take me years to write a program in assembly language to analyze the data.

Analyzed data is plotted on both a line printer and an X-Y plotter through D-A converters. Statistical analyses are also printed on the line printer.

The initial part of the program sets up the transfer characteristics of the 8255. The program then asks for the output file name, and waits for the

Listing 1 continued.

```
*
NAMEIT LMI H.MES1 *SET TO MESSAGE
        SCALL .PRINT *GO PRINT IT
LMI H.FNAME *SET TO FILE NAME STORAGE
PEAR1 SCALL .SCIN *GET CHARACTER
        JC REA1 *LOOP UNTIL READY
        MOV M.A *STORE IT
        INX H *BUMP IT
        CPI 0120 *IS IT A CR?
        JNZ REA1 *NOT YET
        DCM H *YES SET BACK
        MUI M.A
        INX H
        MUI M.FNAME
        INX H
        MUI M.A
        INX H
        MUI M.T
        INX H
        MUI M.O *TERMINATE WITH 00 NOT 120
        MUI A.1 *CHANNEL 1
        LMI D.DEFAULT
        LMI H.FNAME
        SCALL .OPENW *OPEN CHANNEL
        JC ERR1 *ERROR TRY AGAIN
*
* INITIALISE MEMORY AND WAIT FOR START
*
*
*
        CALL INIT *SET UP MEM
        CALL ZBUF *SET UP BUFFER
        LMI H.MES4 *READY TO START?
        SCALL .PRINT *GO PROMPT
        SCALL .SCIN *GET REPLY
        JC TERM
        CPI 00AH *IS IT A CR?
        JNZ TERM *NO TRY AGAIN
*
*
* START GETTING INTERVALS
*
        LMI H.ON *SET TO MARK COUNTER
        MUI M.000H *ZERO IT
        LMI H.PRE *OKAY BEGIN-SET HL TO PRESTIM STORAGE
        LMI D.20000 *SET UP MAX STORAGE COUNTER
        LMI B.00000 *SET UP DATA POINT COUNTER
        MUI A.010H *SET UP RESET BIT
        OUT DATA3 *RESET OUT
        MUI A.000H *CANCEL
        OUT DATA3 *
        IT
```

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user to type a carriage return to begin data entry. A program loop constantly examines the data input port, looking for data pulses, mark pulses or the stop bit. Prestimulus intervals are stored in one block of memory, stimulus intervals in another and poststimulus intervals in a third. The size of the assigned blocks are generous, and can be adjusted according to your needs.

Once the data has been entered, the program enters a binary-to-ASCII conversion routine, and the data is written to the output file (usually a disk). When the pre-, during- and post-blocks of memory are sequentially written to the output file, an asterisk is placed in the data stream on the disks between the blocks of data. Thus, when the disk is subsequently read, the BASIC program can use these markers in data analysis.

Because the program is written for the Heath disk operating system, it uses various system calls and begins above the first 8K of memory. These may have to be altered to run on other machines.

Conclusions

We've been using this system in the

Listing 1 continued.

```

WAIT    IN    DATA3    *GET DATA PORT
        AND    00FH      *MASK OUT UPPER NIBBLE
        CPI    001H
        JZ     COUNT    *PULSE PRESENT GO GET INTERVAL
        CPI    000H
        JZ     WAIT     *NO PULSE YET TRY AGAIN
        CPI    002H
        WAIT    *STILL NOT READY
        CPI    003H
        JZ     MARK    *MARKER AND PULSE PRESENT CHANGE STORAGE
        CPI    006H
        JZ     AFT      *MARKER AND END BIT SET?
        JMP    COUNT    *YES FIX AND CONVERT
        *NON OF ABOVE MUST HAVE ENDED INPUT

MARK:   IN    DATA1
        MOV    M,A
        INC    B
        IN    DATA2
        MOV    M,A
        INC    B
        LXI    H,0N      *SET TO MARK COUNTER
        MOV    A,M
        CPI    000H      *BRING IT INTO A
        JNZ    MARK2    *IS IT SET?
        INR    M          *YES SET TO NEXT BLOCK
        PUSH   B          *SET IT
        POP    H          *COPY B-C
        SHLD   PRESTIM   *INTO H-L
        LXI    B,000000  *STORE COUNT
        LXI    H,STIM    *SET H-L TO STIM STORAGE
        JMP    ZERO      *GO DO MORE
        MARK2  PUSH   B   *COPY B-C
        POP    H          * INTO H-L
        SHLD   DUSTIM    *SAVE B-C COUNT
        LXI    B,000000  *ZERO B-C
        LXI    H,POST    *SET H-L TO POST STIM
        JMP    ZERO      *DO MORE
COUNT  IN    DATA1     *GET LSBYTE
        MOV    M,A
        INC    H          *STORE IT
        INC    B          *SET TO NEXT LOC
        IN    DATA2    *COUNT IT
        MOV    M,A
        INC    H          *GET MSBYTE
        INC    B          *STORE IT
        DCR    B          *BUMP MEM
        DCR    D          *COUNT IT
        MOV    A,D        *IS DE ZERO YET?

```

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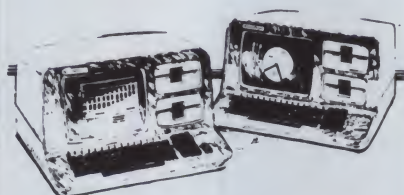
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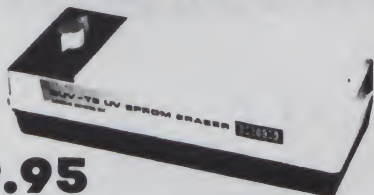
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Listing 1 continued.

```

ORA      E
JNZ      ZERO      *NO DO SOME MORE
AFT      PUSH      B      *COPY BC INTO
          POP       H      * INTO HL
          SHLD      DUSTIM *SAVE DATA POINT COUNT
          LXI       B,0000H *RESET DATA POINT COUNTER
          LXI       H,POST  *SET TO NEXT STORAGE AREA
          IN        DATA1 *GET LAST INT
          MOV       M,A
          INX       H
          INX       B
          IN        DATA2
          MOV       M,A
          INX       B
          PUSH      B      *COPY B-C
          POP       H      *INTO H-L
          SHLD      POSTIM *STORE COUNT
          LXI       H,BUFFER *SET TO START OF BUFFER
          SHLD      TRANS  *STORE START ADDRESS
          LXI       H,256D  *LOAD HL WITH BUFFER COUNT
          SHLD      ZEROH  *STORE COUNT
          LXI       H,FLAG  *SET TO FLAG LOC
          MUI       M,000H  *ZERO IT
          MUI       H,ON    *SET TO MARK STORAGE COUNTER
          MUI       M,000H  *ZERO IT
          LHLD      PRETIM  *GET PRESIM DATA COUNT
          PUSH      H
          POP       B      * AND COPY IT
          LXI       H,PRE   *SET TO PRETIM STORAGE
    
```

```

*
* BEGIN BINARY TO ASCII CONVERSION
*
AGAIN    LXI       D,1000D
          CALL      DIVIDE
          LXI       D,1000D
          CALL      DIVIDE
          LXI       D,100D
          CALL      DIVIDE
          LXI       D,10D
          CALL      DIVIDE
          LXI       D,1D
          CALL      DIVIDE
          DCX       B
          MOV       A,B
          ORA      C
          JZ        DONE
          DCX       B
          MOV       A,B
          ORA      C
          JZ        DONE
          INX       H
          INX       H      *SET TO NEXT INT PAIR
          MUI       A, /
          CALL      BUFIT  *SET UP A SPACE IN A
          PUSH      H      *GO STORE IT
          LXI       H,FLAG *RESET FLAG
          MUI       M,000H
          POP       H
          JMP       AGAIN  *DO ANOTHER
          DIVIDE    PUSH      H
          LXI       H,ASCII *SET TO ASCII COUNTER
          MUI       M,02FH  *STORE ONE LESS THAN ASCII 0
          POP       H
          MOV       A,M
          SUB       E
          MOV       M,A
          INX       H
          MOV       A,M
          SUB       D
          MOV       M,A
          PUSH      H
          LXI       H,ASCII
          INR       M
          POP       H
          DCX       H
          JNC       DLOOP
          MOV       A,M
          ADD       E
          MOV       M,A
          INX       H
          MOV       A,M
          ADD       D
          MOV       M,A
          PUSH      H
          LXI       H,ASCII
          MOV       A,M
          POP       H
          DCX       H
          PUSH      H      *SAVE IT
    
```

```

*
* LEADING ZERO SUPPRESSION
*
CPI      '0'      *DOES IT CONTAIN AN ASCII 0
OKPR     OKPR      *NO GO SAVE IT
          LXI       H,FLAG *YES WHAT IS FLAG STATUS?
          MOV       A,M
          LXI       H,ASCII *GET ASCII BACK
          MOV       A,M
          JC        OKPR   *GO SAVE IF CARRY SET
          POP       H      *OTHERWISE DISCARD
          RET
          OKPR     LXI       H,FLAG *SET FLAG
          MUI       M,001H
          POP       H
    
```

STORE ASCII OUTPUT IN BUFFER

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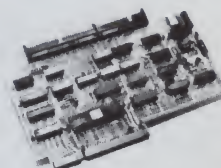
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Listing 1 continued.

```

BUFIT  PUSH  H
      LHALD  TRANS  *GET CURRENT BUFFER LOC
      MOV    M.H    *STORE CONTENTS OF H
      INX    H       *BUMP BUFFER STORAGE LOC
      SHLD   TRANS  *STORE IT
      LHALD  ZEROM  *GET CURRENT BUFFER COUNT
      DCR    H       *DECREMENT IT
      SHLD   ZEROM  *STORE IT
      MOV    A.H    *IS BUFFER COUNT
      ORH    L       *ZERO SET?
      POP    H
      LD     WRITE  *GO WRITE IF SO
      RET                      *OTHERWISE RETURN

+
+   WRITE ASCII BUFFER TO OUTPUT FILE
+
WRITE  MVI    A 1      *WRITE ON CHANNEL 1
      PUSH   H         *SAVE ALL REGS
      PUSH   B
      PUSH   C
      LMI    B,256D    *GO WRITE BUFFER
      LMI    D,BUFFER
      SCALL  JWRITE
      JC     ERR2
      CALL   ZBUF
      POP    C
      POP    B
      LMI    H,BUFFER *SET TO BUFFER START ADDR
      SHLD   TRANS    *GO STORE IT
      LMI    H,256D    *RESET BUFFER COUNTER
      SHLD   ZEROM    *AND STORE IT
      POP    H
      RET            *NO DO SOME MORE

DONE1  LMI    A,ON     *CHECK MARKER COUNT STAT
      MOV    A,M
      CPI    000H      *IS IT ZERO?
      JNZ    DONE1     *NO SET TO NEXT BLOCK
      INR    M         *YES-SET IT TO 1
      MVI    A,*
      CALL   BUFIT     *GO STORE AN ASTERISK
      LHALD  DUSTIM    *LOAD H-L WITH COUNT
      PUSH   H         * AND COPY
      POP    B         * IT INTO B-C
      LMI    H,STIM    *SET TO NEXT BLOCK
      JMP    MORE      *GO DO SOME MORE

DONE1  CPI    001H      *IS IT SET TO 1?
      JNZ    DONE2     *NO MUST BE FINISHED
      INR    M         *YES SET TO 2
      MVI    A,*
      CALL   BUFIT     *GO STORE AN ASTERISK
      LHALD  POSTIM    *LOAD H-L WITH COUNT
      PUSH   H         * AND COPY IT
      POP    B         * IT INTO B-C
      LMI    H,POST    *SET H-L TO NEXT BLOCK
      JMP    MORE

DONE2  LHALD  TRANS
      MVI    M,0120
      INX    H
      MVI    M,0120
      MVI    A,1
      LMI    B,256D
      LMI    D,BUFFER
      SCALL  JWRITE
      JC     ERR2
      JMP    EXIT

+
+   MISCELLANEOUS SUBROUTINES
+
INIT   LMI    H,PGE
      LMI    B,500D
NEXT   MVI    M,000H
      INX    H
      DCR    B
      MOV    A,B
      ORH    C
      JNZ    NEXT
      LMI    H,STIM
      LMI    B,300D
      MVI    M,000H
NEXT2  INX    H
      DCR    B
      MOV    A,B
      ORH    C
      JNZ    NEXT2
      LMI    H,POST
      LMI    B,500D
NEXT3  MVI    M,000H
      INX    H
      DCR    B
      MOV    A,B
      ORH    C
      JNZ    NEXT3
      RET
ZBUF   LMI    H,BUFFER
      LMI    D,256D
DOAG   MVI    M,000H
      INX    H
      DCR    D
      MOV    A,D
      ORH    E
      JNZ    DOAG
      RET
ERR1   LMI    H,FILER *SET TO ERROR MESSAGE
      SCALL  JPRINT  *PRINT IT
      JMP    NAMEIT  *TRY AGAIN
ERR2   LMI    H,MES6 *SET UP ERROR MESSAGE

```

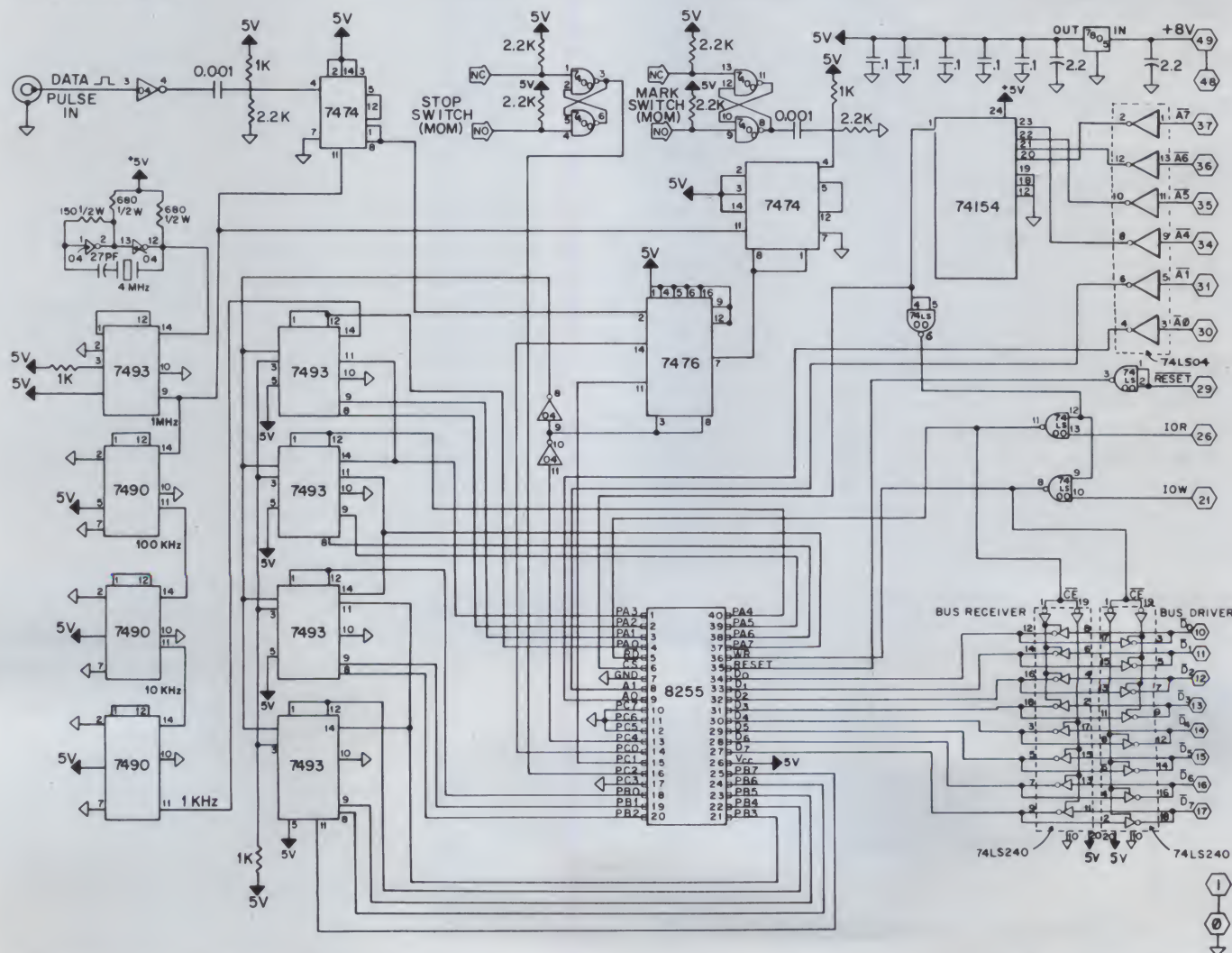
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Someone may ask why I didn't design the interface to measure frequency directly since the neural code is frequency modulated. It would in fact have been much simpler to do this, and only an eight-bit binary counter would have been required. However, average frequency obscures many of the subtleties of neural discharge patterns that may be an important part of the code. By measuring intervals between action potentials, all forms of data analysis become possible, including instantaneous and average frequency.

Listing 1 continued.

```

SCALL .PRINT
XRA A
SCALL .EXIT +TRY AGAIN
EXIT MVI A,1
SCALL .CLOSE
JC ERR2
LXI H,MES5
SCALL .PRINT
PEARZ SCALL .SCAN
JC REARZ
CPI 'Y'
JZ NAMEIT
XRA A
SCALL .EXIT
+
+
+
MESSAGES
MES1 DB 120 FILE NAME? EG. SV1:NAME.THE COMPUTER WILL ADD .DAT'.//+200
Q
FILEP DB 120 'ERROR IN FILE NAME'.//+2000
MES4 DB 120 'PRESS RETURN WHEN READY'.//+2000
MES5 DB 120 'ANALYSE MORE DATA? Y OR N.'.//+2000
MES6 DB 120 'SERIOUS ERROR'.//+2000
DEFAULT DB 'SV0:'.0.0.0
PRE DS 5000
POST DS 5000
STIM DS 30000
PRES TIM DS 20
POSTIM DS 20
DUSTIM DS 20
OIL DS 10
BUFFER DS 2560
ASCII DS 801H
CALCULAT DS 802H
ZEROM DS 802H
FLAG DS 801H
TRANS DS 802H
FNAME DS 200
END BEGIN
```



Microcomputing, January 1982 79

Planetarium Shows With a Difference

By Susannah C. West

Imagine you're sitting in a planetarium, waiting for the show to start. The lights dim slowly and stars appear on the darkened dome above you, as clean and bright as if you were miles out in the country. The show begins. But in this show, you see and experience much more than stars. Comets streaking across the sky. The eerie flicker of the Aurora Borealis. A tiny earth as seen from space, revolving silently, high on the dome above you. A violent blinding flash, so sudden that it shakes you in your seat—a sun going nova.

Many modern planetarium shows feature such spectacular special effects, rivaling those in today's movies. With the help of a computer to automatically coordinate the production of these special effects, they can be astonishingly realistic.

A Computer-Automated Planetarium

The Strassenburgh Planetarium of the Rochester Museum & Science Center in Rochester, NY, is a leading

example of a computerized planetarium. When the Strassenburgh opened in 1968, a custom-designed system controlled by a PDP-8 computer produced its shows' effects. Last summer, the planetarium switched from the PDP-8 to a microcomputer system designed specifically for producing multimedia shows—the MC-10 Media Control System, manufactured by R. A. Gray, Inc. of San Diego, CA.

The decision to switch was prompted by the fact that the PDP-8 was obsolete—parts and service were becoming increasingly difficult to obtain. After 13 years, the old system was still working "virtually perfectly," according to planetarium director Don Hall, who adds that "to get the kind of service we've had out of it is just miraculous. However, it was obvious that we had to junk a working system and buy something to replace it, just so we would get parts and service and be confident that we were going to be able to remain in business."

The careful search for a new system took about a year, and others besides the MC-10 were considered. The staff found out about the MC-10 through word of mouth—from a former Strassenburgh intern who had gone on to the Reuben H. Fleet Space Theater in San Diego, which uses an MC-10 to produce its special effects.

"The MC-10 is essentially a microprocessor that is built by another San Diego company called Gnat," explains Hall. "They build the brain, you might say, and then R. A. Gray builds the various modules that allow it to control the devices in the planetarium theater. So if you have ten Carousel projectors that you want to control in the theater, you buy ten Carousel units as part of your computer system. You buy just what you need, and you can expand the system, because it is modular."

The planetarium staff planned the switch-over carefully. After receiving the MC-10 equipment, they spent about four months learning about the system and interfacing it with the planetarium's devices. During this phase, the PDP-8 continued to produce the special effects for shows.

On June 21, 1981, the final installation began, right on schedule. It took five days to move out the old equipment, move in the new equipment and plug it in. "Except for a few initial difficulties," says chief technician Carl Dziedzic, "she's been quite good—hasn't given us any problems."

R. A. Gray describes the MC-10 as a "general-purpose media controller



Photo 1. Strassenburgh Planetarium of the Rochester Museum & Science Center. (Photo by William G. Frank.)

Susannah C. West (224 Selye Terrace, Rochester, NY 14613) is a free-lance writer.

designed especially for recording and playbacks of multimedia presentations." The hardware consists of two disk drives, used to record and store performance information, two monitors, a keyboard and a variety of modules that can control up to 120 devices at one time. These can include not only equipment like lights and projectors, but also tape machines, speakers, robots and puppets.

The MC-10 incorporates three levels of operation. The highest level (maintenance) allows development of all features of the operating environment. Devices can be added or removed from the working environment and named as they will be displayed on the monitors. When it becomes necessary, the system can also be tested for maintenance.

The second level (production) allows editing and storage of "scripts" of performances. Because the system recognizes commands in English, programming is no problem, even for the computing novice.

The third level (operation) is for playback and setup. The play mode recalls previous performances. The setup mode allows user control of devices in real-time without recording for review and experimentation without editing.

At either of the first two levels, disks can be produced to allow functions at or below that level and no higher. Thus, disks for production are unable to destroy or modify the basic system features and controls; and disks for playback cannot be erased or edited by operators. This scheme provides both protection and security.

Recording Shows with the MC-10

"When we want to record a 45-minute show," says Hall, "we break it up into ten or 20 shorter sequences which are each only a few minutes long. We go into the theater with the script with the cues marked in the margin. Two or three people are standing there at the console with their hands on the controls, and are actually giving the show."

The soundtrack for the show has already been taped and is played.

"One person's reading the script," Hall continues, "and he says the cues to the technicians who are operating the effects. And the narrator says, 'And so the rocket takes off for Mars,' and the person giving the cue says, 'All right, fade up C3, hit the non-dim

B-RECORD DISK TIME 37:17:03															REV: 7 NAME: SYSTEM DEMONSTRATION																													
A-PLAY DISK TIME 12:48:00															REV: 6 NAME: SYSTEM DEMONSTRATION																													
TRACKS AVAILABLE: 54															BASE TIME: 15:02:12															BLOCKS ASSIGNED: _ _ 2 _ _ _ _ 8 9														

LT1A	LT2A	LT3A	LT4A	LT5A	LT1B	LT2B	LT3B	LT4B	LT5B	LT1C	LT2C	LT3C	LT4C	LT5C																														
17%	17%	17%	17%	0%	20%	20%	20%	0%	0%	0%	0%	80%	0%	0%																														
RED	RED	RED	RED	YEL	BLUE	BLUE	BLUE	GRN	GRN	STEP	STEP	FOOT	WHT	WHT																														
															TAPE	SPK1	SPK2	SPK3	SPK4	SPK5	SPK6	SPK7	SPK8																					
															PLAY	7	4	7	4	7654																								
															ASMT	21	21		3	0	3	0	65	65			3210																	

BLOCK INFO					DEVICE INFO					FIND W/E					NEW DISK					RAMP					SWITCH																			
CANCEL ALL					DISSOLVE					FLASH					NEXT TIMER					RECORD ADV					VALUE																			
CANCEL CMDS					END					GO					OFFSET					RELAY					WAIT																			
CANCEL DISK					ERASE W/E					HOME TRAYS					OPEN BLOCK					REPEAT BLOCK					?																			
CROSSFADE					EXEC BLOCK					INIT TIMERS					PLAY ADV					SET BASE																								
DELETE BLOCK					FADE					LEVEL					POSIT TRAY					SET TIMER																								
FADE,DEVICE,TIME,DURATION,INITIAL VALUE,END VALUE																																												
R=>FA,LT1A,N,P20S,C,0																																												

SP1A 0% m35	SP2A 0% 40	SP3A 0% 42	SP4A 0% 40	SP5A 0% m36	SPOT 20% SIZE	HUE BLUE YEL	ZOOM 50 SIZE	VIEW 5 NMBR	X 52 ----	
SP1B 20% 31	SP2B 60% 41	SP3B 60% 36	SP4B 60% 37	SP5B 20% 32	BRT 0% SHUT	SHAP RND EVEN	IRIS 20% OPEN	ROT 20 ----	Y -126 ----	
SP1C 40% 28	SP2C 40% 45	SP3C 40% 44	SP4C 40% 41	SP5C 40% 29						
SP1D 20% 24	SP2D 0% 40	SP3D 0% m38	SP4D 0% m36	SP5D 20% 27	SE1 0% FIRE	SE4 80% SEA	SE7 0% RAIN	SE10 0% SNOW	SE13 0% LTNG	SE16 70% CLD
					SE2 0% OFF	SE5 0% OFF	SE8 0% OFF	SE11 0% OFF	SE14 0% OFF	SE17 0% OFF
PANA 0% 8	PANB 0% 8	BALL 20 MOVE	STRB 5 OFF	FILM STOP DOUS	SE3 26% OPEN	SE6 99% BLST	SE9 0% OFF	SE12 0% OFF	SE15 0% OFF	SE18 0% OFF
TIMER: 06=37:16:04 07=37:16:12 << 08=00:00:00 >> 09=00:00:00 10=00:00:00										

tarium projectors which follow the same principle. But the Strasensburgh's projector is a very special one. It's a Zeiss model VI—a Rolls-Royce among planetarium projectors. Built by the West German firm of Carl Zeiss, Inc., it includes many sophisticated components. The most complex of these is the moon projector, which reproduces the phases of the moon and five kinds of lunar eclipses. It also features a sun projector capable of showing the sun's position in the sky for any day of the year, and ten kinds of solar eclipses.

The Star Theatre

With a star projector like the Zeiss, you'd expect the Strasensburgh's Star Theatre to be special too, and it is. It seats 240 people under its 65-foot diameter dome. The seats swivel and recline so you can look up at the dome without getting a stiff neck. You hear the narration from speakers built into the chairs, next to your ears, and music and sound effects from speakers set in the dome.

Narration, music and sound effects are sent to the theater from the control room, which contains the recorders and amplifiers. A projection gallery surrounding the theater contains about 300 projectors which are aimed at different parts of the planetarium sky. The number of projectors varies according to the number needed for the various shows running at any particular time.

The planetarium features several shows simultaneously. A 45-minute show which explores such things as phenomena of the universe or space exploration runs several times a day and in the evening. A 20-minute minishow about the seasonal sky also runs in the evening.

There are shows designed for family audiences, preschool shows which combine live action with star projections, and shows for school groups. In addition, there are special shows, like the 3-D light show which ran during the summer of 1981. And the planetarium staff is always working on shows that will replace current ones when their runs are through. ■



Photo 2. Chief technician Carl Dziedziech at Planetarium console. MC-10 is in background to the left. (Photo by Victor A. Costanzo, Jr.)

and fade up E4.' And those cues 'cause' the rocket to take off for Mars."

Sequences are rarely right the first time. With the old system, perfecting a sequence was laborious, even if only one problem occurred, because the entire sequence would have to be re-recorded. But the MC-10, Hall explains, "allows us to edit the show, once it's been put in, much more easily. If just one thing needs to be done, like a light that fades down just a little too quickly, that part alone can be edited without affecting the other parts of the sequence that don't need changing."

When a show is being recorded, "the computer is scanning all the controls on the console. If anything is moved, it notes its position, and the next time the computer scans around, it will compare the second scan with the first scan; if anything has moved, it makes a note of where it is now. When it comes to the playback of those instructions, we tell the computer, 'Now play back the show.' The computer grabs hold of the controls and will actually operate them."

To develop programs more conveniently, and to have a backup system, two computers were purchased. One computer "sits in the control room and gives the show," says Hall. The other "allows a person to sit in his office, use the typewriter keyboard attached to it and the two monitors, and program the show, just watching numbers appear and change on the screen, take the program on the floppy disk, put it in the computer in the theater, and adjust it there. So recording can be done off-line."

Planetarium Console

The planetarium console is located at the back or side of any planetarium theater. It is here that the operator sits to deliver a show, manipulating knobs and buttons to project images on the dome and operating the star projector so that the appropriate stars will appear. If it's a live rather than recorded show, he delivers the lecture.

The Strasensburgh's console was originally built for use with the PDP-8, but when the decision was made to switch to the MC-10, the console was almost completely redesigned by a time-motion studies expert. Its appearance is quite similar, but there are also differences. For instance, many of the special effects control knobs were replaced with slider controls.

The MC-10 is also part of the console. The video displays show the operator what's going on with the special effects: which projectors are on at any given moment and what their brightness is. By watching the monitors, the operator can easily tell, for example, if a projector bulb is burnt out or if an effect is out of sequence. School shows are usually run manually with a live lecturer, and so the console was designed to allow operation without the MC-10.

Results

Audiences can't really detect the difference between a show produced by the old system and one produced by the MC-10. However, there are differences—and all to the good. Formerly, it took five people two full days to record a show. In contrast, the first shows produced using the MC-10 were recorded by four people in about five hours. As the staff becomes more accustomed to the system, they will be able to record shows in even less time.

In addition, more complicated effects can be achieved with the MC-10. It gives a greater degree of control, so that technicians can do precisely what they want with the effects. The current show, which opened in mid-October 1981, features effects that would have been impossible or very difficult to produce using the old system.

Future for the MC-10

Although the planetarium staff is pleased with the MC-10's performance, there's still a lot of work to be done. Right now, only the special ef-



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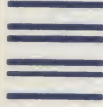
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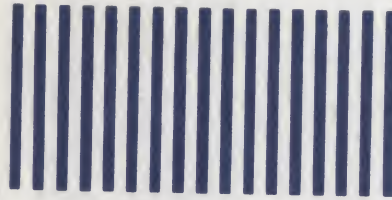
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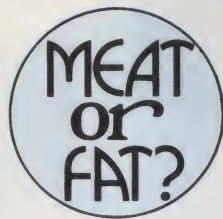
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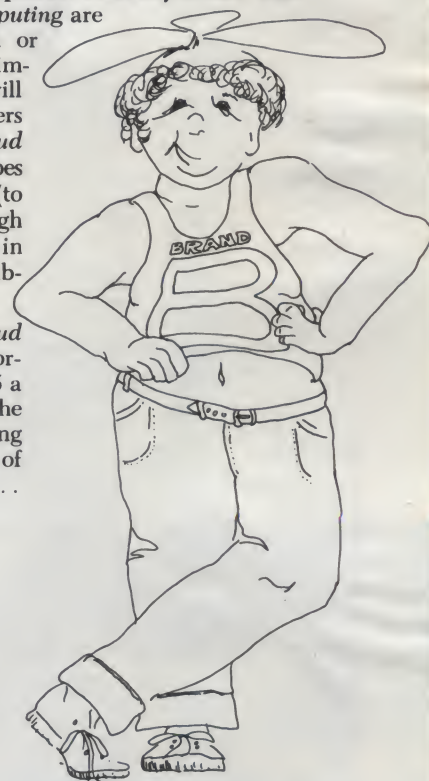
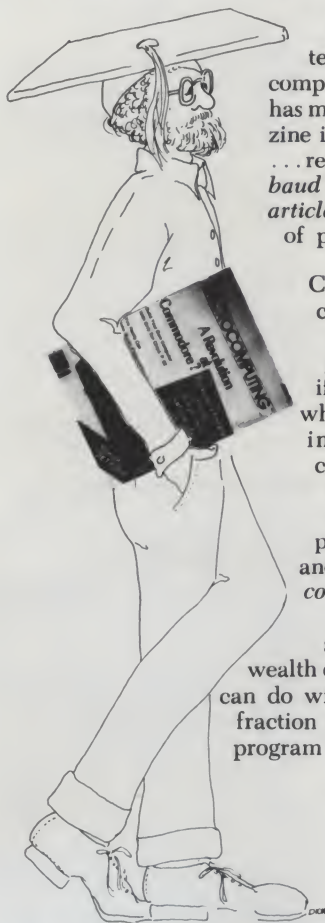
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Photo 3. Close-up of MC-10. (Photo by Victor A. Costanzo, Jr.)



Photo 4. Planetarium's Star Theatre with Zeiss Star Projector in center. (Photo by William G. Frank.)

fects are controlled by the system. However, work has begun on interfacing it with the planetarium's star projector to control its operation.

"It will be a one-on-one situation where we'll be changing over functions one at a time, interfacing on a piecemeal basis, testing as we go along," says Dziedziech, adding that "not all the system gets automated—only those functions that are used 80-90 percent of the time will be computerized." The projector will

be automated by the spring of 1982.

Through this combination of technology and theater, the Strassenburgh Planetarium will strive to produce high-quality shows that will both teach and entertain. ■

References

The MC-10 Media Control System was developed by R. A. Gray, Inc., 9181 Chesapeake Drive, San Diego, CA 92123. 714-560-4162.

The internal computer was manufactured by Gnat Computers, Inc., Building 6, 7895 Convoy Court, San Diego, CA 92111. 714-560-0433.

For more information about the Strassenburgh Planetarium, contact: Donald S. Hall, Director, Strassenburgh Planetarium, Rochester Museum & Science Center, 657 East Ave., PO Box 1480, Rochester, NY 14063. 716-271-4320.

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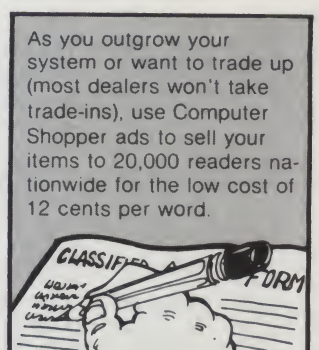
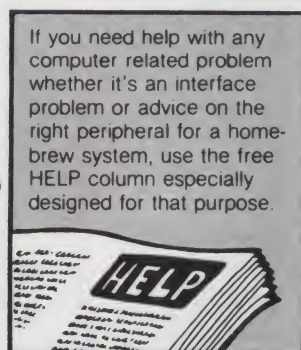
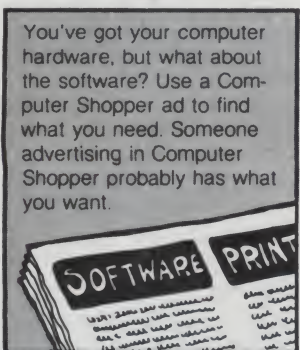
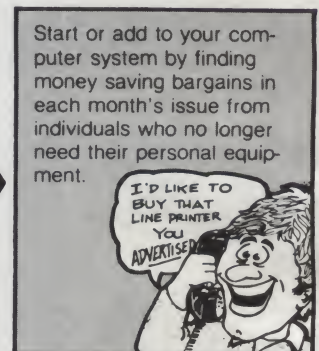
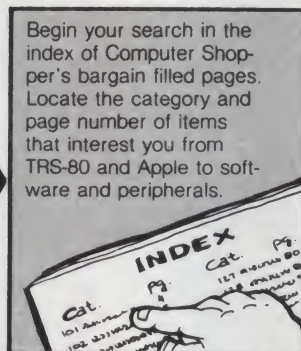
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The Toxic Apple

By Paul E. Gurba, Rolf A. Deininger and Carl F. Berger, Jr.

```
0 REM AMINCO DATA LOGGING PROGRAM
10 GOTO 110
20 NS = 0
30 FOR I = 1 TO 300
40 NS = NS + 1
50 X = PEEK ( - 16384): IF X > 127 THEN 360
60 POKE APl,CH:R(I) = PEEK (A)
70 PRINT R(I) * .0483
80 FOR D = 1 TO DL: NEXT D
90 NEXT I
100 GOTO 360
110 HOME : PRINT "          THIS PROGRAM STORES"
120 PRINT "      DATA TAKEN FROM THE AMINCO"
130 PRINT "      SPECTROPHOTOMETER"
140 FOR I = 1 TO 1500: NEXT I
150 HOME :A = - 14592:AP1 = A + 1:D$ = CHR$ (4):CH = 2
160 DIM R(300)
170 PRINT "WHAT IS THE SAMPLE NAME": INPUT SN$
180 PRINT "ENTER DATE": INPUT DT$
190 PRINT "NAME OF OPERATOR": INPUT NO$
200 PRINT "WHAT TIME BASE ARE YOU USING": INPUT T
210 IF T > = 5 AND T < = 50 THEN GOTO 230
220 PRINT "THE TIME BASE SHOULD BE BETWEEN 5 AND 50": GOTO 200
230 IF T = 5 THEN DL = T * 21.7
240 IF T = 50 THEN DL = T * 120
250 IF T = 20 THEN DL = T * 28.6
260 IF T = 10 THEN DL = T * 24.7
270 PRINT "ABSORBTION SCALE";
280 INPUT AB
290 PRINT "DO YOU WANT TO SAVE THE DATA": INPUT SV$
300 FAC = .0483
310 PRINT "TO START OR STOP TAKING DATA, PRESS ANY KEY"
320 X = PEEK ( - 16384)
330 IF X < 127 THEN 320
340 POKE - 16368,0
350 GOTO 20
360 PRINT NS;" DATA POINTS TAKEN."
370 IF SV$ = "Y" THEN 390
380 GOTO 460
390 PRINT D$;"OPEN";SN$ + "." + DT$
400 PRINT D$;"WRITE";SN$ + "." + DT$
410 PRINT SN$: PRINT DT$: PRINT NO$: PRINT T: PRINT AB: PRINT NS
420 FOR I = 1 TO NS
430 PRINT R(I)
440 NEXT I
450 PRINT D$;"CLOSE";SN$ + "." + DT$
460 END
```

Listing 1. Program used to collect and save data generated by the Aminco analyzer.

Toxicology is the science which deals with the effects of toxic substances (such as pesticides) on living organisms.

To determine the potential and actual health hazard, scientists often measure enzymatic reactions. Many of the pesticides are commonly evaluated for their ability to inhibit acetylcholinesterase (an enzyme), which is important in nervous system functions. The enzyme activity is monitored by the light absorption of a colored complex of DTNB (dithionitrobenzoic acid) and thiocholine, which is released during the course of the reaction. The change in light absorption is monitored continuously with time at 412 nm (nanometers), and the result is recorded on an x-y recorder.

The enzyme activity is then computed using the slope of the tracing along with other parameters such as cuvette volume, amount of protein and molar extinction coefficient. Materials which are inhibitory to acetylcholinesterase will show a lower activity than a control compound.

Although the computation of such enzyme activities is not difficult, the task can be time-consuming when a large number of compounds need to be screened. Additionally, the tracing obtained is not always linear, so there is a need for some way of obtaining a slope by methods less biased than eyeballing it. Once the raw data is collected, statistics and report gener-

Address correspondence to Paul E. Gurba, Rolf A. Deininger, and Carl F. Berger, Jr., Department of Environmental and Industrial Health, School of Public Health, The University of Michigan, Ann Arbor, Michigan 48109.



Photo 1. Aminco recording spectrophotometer with Apple II.

ation are often necessary. We decided therefore to explore the use of an Apple microcomputer for data logging and analysis.

The System

Photo 1 shows the instrument used in our studies: a recording spectrophotometer marketed by the American Instrument Company under the name Aminco. It consists of a photo-multiplier, dual monochrometers and an x-y recorder. The signals to the recorder are available at an output port. A small operational amplifier system (shown with an Interactive Structures A/D converter in Photo 2) scales the output voltage of the Aminco by a factor of about 80. The circuit consists of an LM308 operational amplifier with an input resistance of 13k ohms and a 1 Megohm feedback resistor to produce the desired amplification. A .01 microfarad capacitor is used for noise and internal compensation. The sample is then processed by an eight-bit A/D converter.

Listing 1 shows the program used to collect the data from the instrument. Statements 110 through 340 acquire information on the sample, operator and analysis. Statements 230 through 260 set the delay times for various speeds of analysis. Statement 150 sets the proper slot addresses of the A/D converter, channel number and amplification factor. In response to pressing a key, the actual sampling loop begins at statement 20 and ends at statement 100. Up to 300 samples (which is much more than enough) can be taken. Statements 360 through 460 record all data and the other information on the disk.

Listing 2 shows the program used

```

0 REM AMINCO DATA ANALYZER
10 ONERR GOTO 80
20 DIM R(400)
30 INPUT "WHAT DATA FILE DO YOU WANT? ";FI$
40 D$ = CHR$(4)
50 PRINT D$;"OPEN";FI$: PRINT D$;"READ";FI$
60 INPUT SN$: INPUT DT$: INPUT NOS: INPUT T: INPUT AB: INPUT NS
70 FOR I = 1 TO NS: INPUT R(I): NEXT I
80 PRINT D$;"CLOSE";FI$
90 CALL - 936: HGR : HCOLOR= 3: SCALE= 3: ROT= 0
100 HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0
110 XINC = 279 / NS:YINC = 159 / 255
120 FOR I = 1 TO NS
130 X = XINC * I:Y = 159 - YINC * R(I)
140 HPLOT X,Y: NEXT I
150 GET T$
160 VTAB 21: PRINT "ADJUST PADDLE FOR LOW DATA POINT, PRESS A KEY"
170 GOSUB 440
180 IB = INT (X / 255 * NS)
190 VTAB 21: PRINT "ADJUST PADDLE FOR HIGH DATA VALUE, PRESS ANY KEY"
200 GOSUB 480
210 IE = INT (X / 255 * NS)
220 TEXT
230 REM SLOPE
240 AD = .0445
250 SX = 0:SY = 0:XY = 0:X2 = 0:N = 0
260 FOR I = IB TO IE
270 X = I / 20
280 PRINT "X= ";X,"Y= ";R(I) * AD
290 N = N + 1
300 SX = SX + X:SY = SY + R(I) * AD
310 XY = XY + X * R(I) * AD:X2 = X2 + X * X
320 NEXT I
330 SL = (SX * SY - N * XY) / (SX * SX - N * X2)
340 AS = AB * SL
350 PRINT "THE SLOPE IS ";SL: PRINT "YOU USED ";N;" DATA POINTS"
360 PRINT "INPUT MILLILITERS VOLUME": INPUT MV
370 PRINT "INPUT THE MOLAR EXTINCTION COEFFICIENT": INPUT E
380 PRINT "INPUT MILLIGRAMS PROTEIN": INPUT P
390 MO = (AB / 10) * (1 / E) * (MV / 1000)
400 TI = T * (1 / 60)
410 SP = SL * (MO / TI / P)
420 PRINT "THE SPECIFIC ACTIVITY IS ";SP
430 END
440 REM LINES 1010-1030 DEFINE CURSOR
450 FOR I = 0 TO 11: READ BYTE: POKE 768 + I,BYTE: NEXT I
460 DATA 1,0,4,0,63,9,9,63,18,36,36,0
470 POKE 232,0: POKE 233,3
480 X = PDL (0) * 1.0941:Y = PDL (1) * .6235
490 XDRAW 1 AT X,Y
500 FOR D = 1 TO 60: NEXT D
510 XDRAW 1 AT X,Y
520 U = PEEK ( - 16384): POKE - 16368,0
530 IF U < 127 THEN 560
540 HPLOT X,0 TO X,159
550 RETURN
560 GOTO 480

```

Listing 2. Program used to analyze the data.

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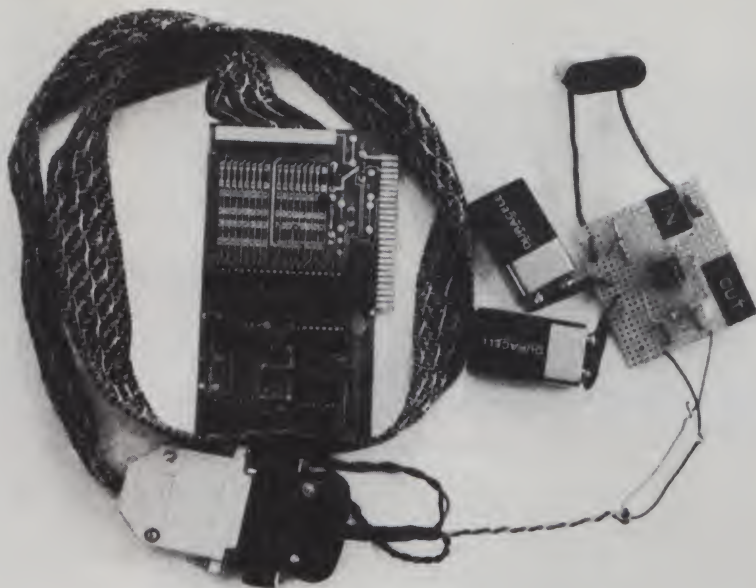


Photo 2. Amplifier board with A/D converter.

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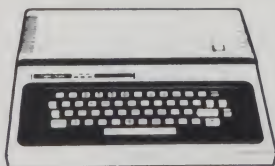
for analyzing the data. Statements 30 through 80 read the data from the specified file. Statements 90 through 140 plot the data on the Apple high-resolution screen. Using the paddles, the operator defines with a flashing cursor on the screen the range of data to be selected. Statements 450 through 470 define the cursor shape, and statements 480 through 550 draw the cursor on the screen and then delineate the range of the data selected. Statements 230 through 330 calculate the slope of a least squares line through the data. Statements 360 through 380 ask for further pertinent

information, and lines 390-410 finally calculate the desired result of specific activity.

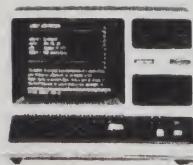
Conclusion

Use of the Apple for measurement of enzyme activity saves us time in the laboratory. Besides collecting the raw data, we can easily do data reduction, statistics, and report generation of results which are stored in the Apple. Furthermore, we can transfer our data and results to a large main-frame computer for other types of analyses by attaching our modem to the Apple. ■

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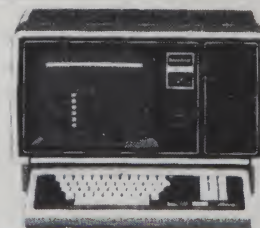


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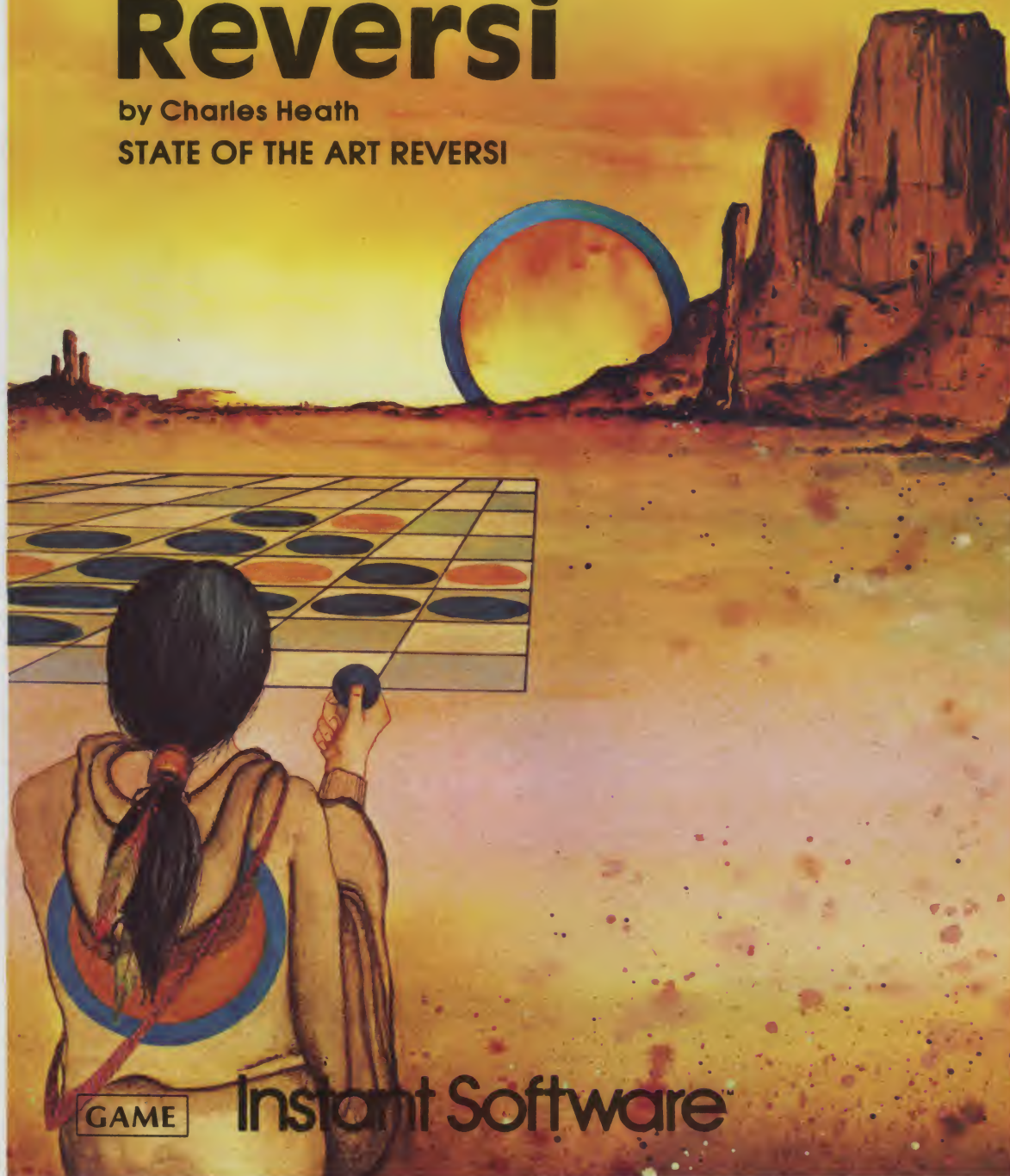
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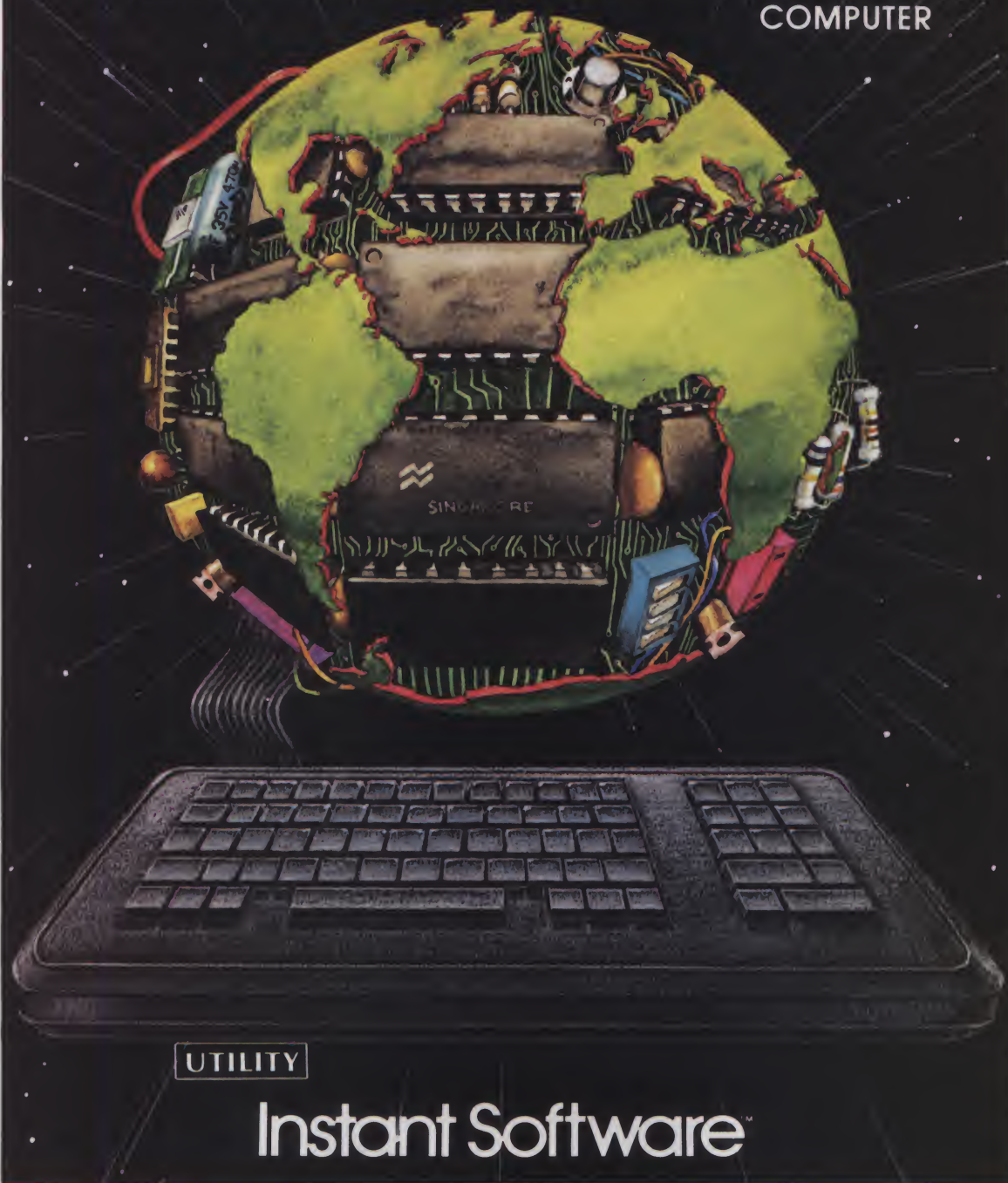
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There are two fundamental problems with the study of these criteria in that article. First of all, much of the information is just plain false, and secondly, the most significant use of microcomputers in a large (or small) business application is not even considered.

Let's take a look at what I consider to be some of the misinformation. One expert points out that the typical 16-bit micro offers substantially less arithmetic precision than a 32- or 48-bit mini or supermini. "The run-of-the-mill 16-bit micro might offer seven digits of accuracy, which would be fine for payroll, but wouldn't do in the stress analysis of an aircraft element," he says. "The 48-bit Harris 800 supermini (which sells in full-system configuration for about \$400,000) offers 20 decimal digits of precision, which can be a big help to an engineer."

Well, IBM's new Personal Computer offers 17-digit precision at a cost of under \$3000. That's quite a price difference for three decimal places. (Also the Atari 800 and the TRS-80 in double-precision mode offer 16-digit precision.)

"Typically, the user can address 256 bytes of memory in the typical 16-bit micro. . . . This limits the size of the programs that can be used and the amount of data the program can compute on at any one time."

In a strictly technical sense that's absolutely true. Minis can directly address millions of bytes of memory. But with a good disk operating system (especially using hard disks) and good I/O programming, a micro can handle the same applications and the same amount of data with some time difference and with a huge cost difference.

A mini manufacturer is quoted as saying, "One of the biggest differences between a micro and a mini is that today's micros have very limited capabilities. . . . Minis, on the other hand, are inherently more flexible and generally expandable in terms of software migration to bigger systems." Another key factor, he says, is that minis have a friendly operating system and the user can readily run multiple applications.

Granted, no single micro has the capabilities of a good mini—but in many applications a system of micros

can offer the same capabilities as a mini at a significant cost difference. Such micro systems can be just as flexible and expandable as a mini. And micros, just as minis, have friendly operating systems and can run multiple applications (see, for example, "Multiprocessor or Multitask" by Ken Barbier in the June 1981 *Microcomputing*, p. 34).

Another mini user quoted in Seaman's article says, "If I wanted to build a flight simulator for a Boeing 747, there is no micro or micro software that can handle the algorithms involved."

True. If I had to build a Boeing 747 flight simulator I too would want to use a mini (though, in fact, a system of micros could do a very respectable job), but how many businesses need a computer system with the capability to build a flight simulator for a Boeing 747? Also, you can buy, off the shelf,

A system of micros
can offer the same
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flight simulators for smaller aircraft that run on small micros.

"General Automation's (Anaheim, CA) Nocode software system permits development of applications software in a much shorter time and with a smaller staff. Nocode runs on GA's Instacode computer system. . . . Nocode will not run on microcomputers."

Nocode sounds like a fine system that does the same job as software like Pearl II and The Last One, which run on a variety of microcomputers. By the way, the Nocode system sells for \$40,000 to \$150,000—that's two to three decimal places of difference from the cost of the micro software.

This is only an indication of the misinformation that the computer customer has to sift through. Whether it results from ignorance of what micros can do, or from a desire to sell more costly products for higher commissions, is an open question. Let the buyer beware. The second problem with Seaman's article is one of omission. There is no discussion of the use of microcomputers in a networked environment with either a mini or larger micro as a system host.

A network of microcomputers, which may or may not include a mini, can be the ideal solution for many applications. It is an alternative that renders most of the mini-vs-micro arguments moot. If networking is brought into the discussion, there is virtually no difference between mini systems and systems of micros except, possibly, price. The cost of a micro network in which the micros can also serve as terminal work stations for a mini would actually be more costly than a conventional mini/terminal system, but the differences in computing power, number of possible work stations and productivity could well be worth the difference for very large applications. (For more information on networking see Brandt and Bodner's article on distributed intelligence networking and the Oct. 1981 issue of *BYTE*.) But for most applications networking will present a significantly less costly alternative.

Networking also offers a different perspective on the questions of service and down time. The good mini manufacturers by and large have excellent service organizations. Many micro manufacturers are working to catch up. But use of a network greatly diminishes the significance of the service and down-time issues. Put quite simply, if one computer in a network is down the entire system is not brought to a grinding halt. The others can, in the worst case, still be used as stand-alone systems. Some power may be lost while service or replacement is carried out, but some production can continue. This makes a network a truly attractive alternative to either a mini or a micro single-computer system that is completely down when the one processor is down.

Minicomputers are excellent machines and indispensable for many jobs—it would be foolhardy to argue otherwise. But there are a significant number of applications where micros and networking are the answer. Micros will not completely replace minis, just as minis have not completely replaced mainframes. The propagation of misinformation about what different systems can and can't do has to be harmful to the entire computer industry in the long run (and it isn't helping faculties to convince their administrations of the need for a variety of equipment to best prepare their students for work in that industry. ■)

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Changing Chips In Midstream

By Michael A. Wolf

If you're like me, a dyed-in-the-wool 68XX user, you've been wishing a big company would select a 68XX microprocessor for a low-cost, serious home computer. You've been gritting your teeth every time someone announces a new 6502 or Z-80-based product.

Well, Radio Shack has done it—their TRS-80 Color Computer has a 6809 microprocessor. Not only that, but look at these features: color graph-

ics, RS-232, joystick and cassette interface, sound, 4K bytes of programmable random-access memory (RAM) expandable to 16K and an 8K byte read-only memory (ROM) BASIC. All for \$399. I bought it on the spot and took it home.

The Color Computer comes in a 13¼ by 14¼ by 3½ inch package weighing about five pounds. It has a 53-key keyboard, and displays 16 lines of 32 characters on a standard

TV set. A slot in the right side accepts a plug-in ROM pack for prepackaged programs. If they don't suit you, you can write your own, using the excellent Microsoft BASIC provided.

Also included are a user's manual, a learner's guide to Color BASIC (as good or bad as the TRS-80 Level I book) and a quick reference card listing all the commands in the BASIC.

I hooked it up to a TV, using the supplied cable and antenna switch, and started running some sample programs. My first impressions were favorable. The keyboard takes some getting used to—it feels different from a regular keyboard—but it isn't bad. My old TV took some adjusting to get a good display, but when properly set up, it was quite satisfactory, giving vivid colors and nice black-on-green characters. The standard graphics are coarse at low resolution (64 by 32 pixels), but finer resolution (up to 256 by 192 pixels) is possible with 16K machines and Extended BASIC.

The Package

About this time, curiosity got the better of me and I opened the case to see how they could sell so much for so little. What I found is an example of how large-scale integrated (LSI)



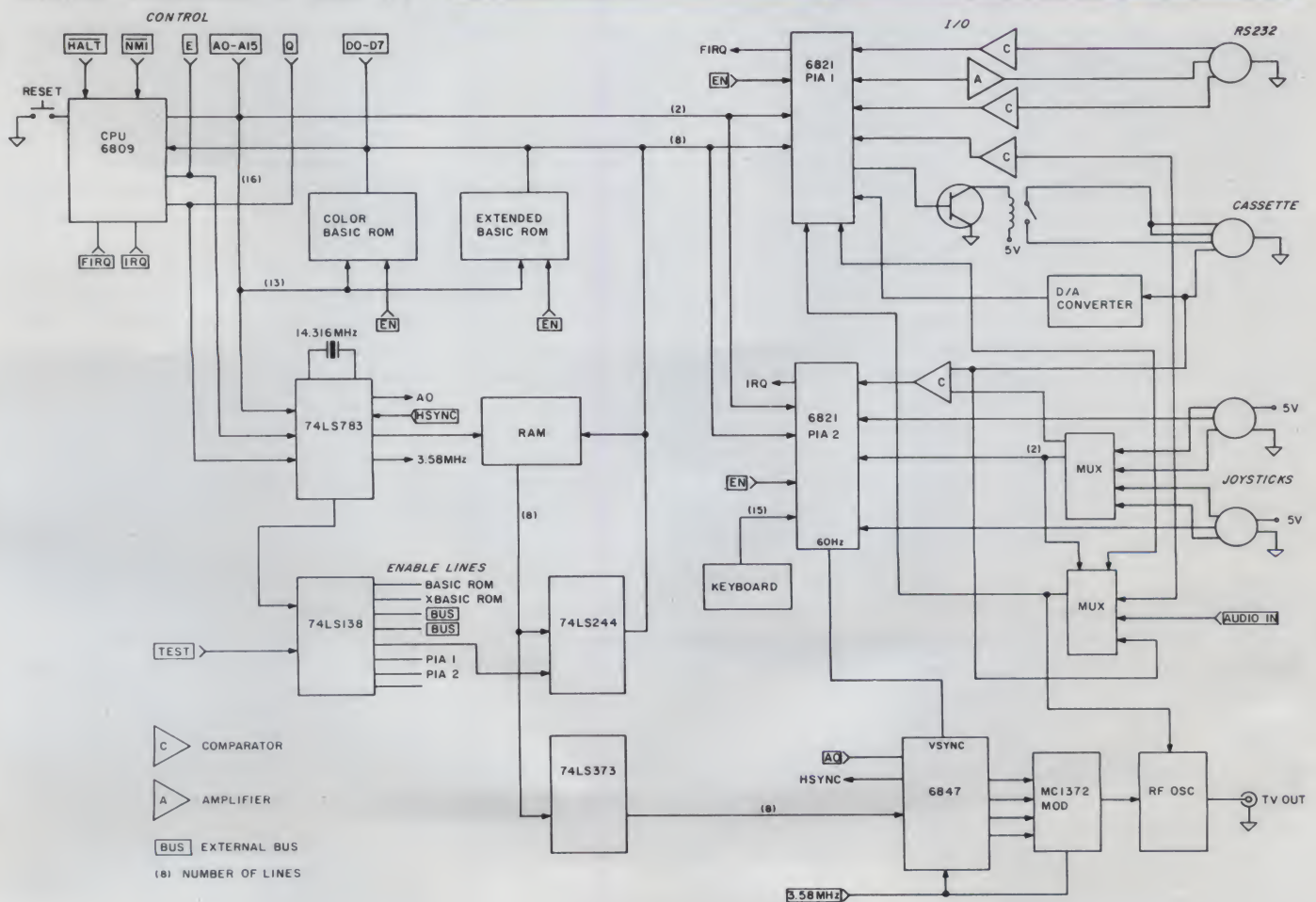
Color Computer screen displays using Extended Color BASIC. (Photos by Harold Nelson.)

Address correspondence to Michael A. Wolf, Atomic City Electronics, Arizona Ave., Los Alamos, NM 87544.

There are four jacks on the rear for two joysticks, a cassette recorder and an RS-232 interface. The RS-232 is a

600 bits-per-second (bps) interface suitable for a printer. Radio Shack offers software and a modem to make your Color Computer useful as a ter-

In addition to these LSI chips, there are eight RAM chips (4027s for the 4K machine, 4116s for the 16K version), two 6821 parallel-interface adapter (PIA) chips, which handle most of the I/O; and a single 68364 ROM containing the 8K Color BASIC. Also included is a handful of support chips. The power supply occupies about one-third of the single circuit board, and the computer section of the board is enclosed in a metal shield to conform to the Federal Communication Commission's radio fre-



Microcomputing, January 1982 97



minal for videotext. The data rate is easily changeable up to 2400 bps by a POKE statement from BASIC.

The cassette port is a 1500 bps interface to a standard cassette recorder, with motor control, and it operates similarly to a TRS-80 Model I. It is three times as fast (and it doesn't have the dependence on volume settings that the earlier model had). It took only three tries to get the proper setting on my recorder (not the recommended model), and I've had few problems since then that weren't caused by me.

The video interface is a compromise. To get 32-character lines requires all the video bandwidth you can get out of a color TV through the antenna input. To get more characters would require a color monitor, which costs about twice as much as the Color Computer. Also, the VDG's character generator doesn't put out lowercase letters. They compromise by allowing lowercase in strings. The computer displays them in reverse video.

However, when you send them out the RS-232 interface, they go out as lowercase and are printed as such on a printer. This is better than a TRS-80 Model I, which had no provision for lowercase at all. Several modifications were designed to overcome this in the Model I, and it would be possible to modify the Color Computer too, since the 6847 allows for an external character generator.

The connector for the external pro-

gram packs is a 40-pin edge connector, which has more signals available than just those necessary for a ROM pack. Radio Shack did their homework on this. Not only are all the address, data and important control lines available; there are two decoded select lines for programs and I/O.

Also, a signal on one of the pins lets you disable any of the internal resources and substitute external I/O or memory anywhere in the address space. This allows such tricks as overlaying special routines on top of the BASIC, adding external RAM anywhere in memory or substituting an external I/O port for the one that's in the box. It looks like they planned for a future expansion bus.

Control may be easily transferred to your own machine-language routines upon interrupt by poking a jump instruction at the appropriate memory location.

How Does It All Tie Together?

First, look at the block diagram in Fig. 1. The microprocessor and VDG share the RAM, using a technique called interlacing. During part of a machine cycle, memory is accessed by the video generator, and during the rest of the cycle by the processor. This is made possible by the consistent machine cycle length of the 68XX family of processors. Each machine cycle has two memory cycles. The first provides the data for the video generator; the data is latched halfway

through the cycle. The second access is for the processor. All this juggling is handled by the SAM.

The SAM has provisions that let you select either graphics mode, the base address of the display memory, the type of memory used (up to 96K is possible) and even select between two types of memory maps.

The joysticks use a six-bit digital-to-analog (D/A) converter and a comparator to generate numbers from 0-63 proportional to the voltage on the joystick connectors. This could be used for a number of things in addition to joysticks. The voltage must be between 0 and +5 V.

VDG

Let's look further at the 6847 video display generator (VDG). The VDG has two alphanumeric, two semigraphics and eight full-graphics modes.

- A/G (alpha/graphics) switches from alpha/semigraphics mode to full-graphics mode.

- A/S (alpha/semigraphics) switches from alpha to one of the two semigraphics modes.

- INV causes the alpha display to be reversed (green-on-black or black-on-green).

- INT/EXT lets you use an external character generator in the alphanumeric mode, and switches between the two semigraphics modes.

- GM0, GM1 and GM2 are the full-graphics control lines, and control the various graphics options, from 64 by 32 pixels (picture elements) to 256 by 192.

- CSS, color set select, switches sets of graphics colors and background color for the graphics modes with limited color selections.

The machine comes up in the alpha/semigraphics mode, and is in semigraphics 4 when in semigraphics. Each character space is divided into four pixels, which can either be black or one of eight colors, but the whole character space must be the same color. A POKE 65314,16 switches to semigraphics 6, which limits you to two sets of four colors but gives you 64 by 48 pixels. These are more nearly square, and thus make graphics look better. However, Set, Reset and Point don't work in this mode. It also switches to external character mode, so alphanumerics are not usable.

The graphics modes are also available but require more memory than BASIC allows in a 4K machine, so are limited to a 16K box. They also re-

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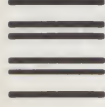
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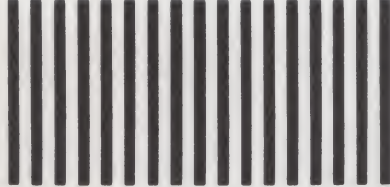
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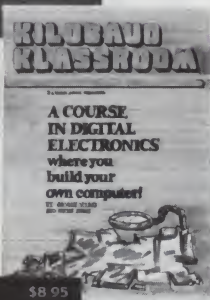
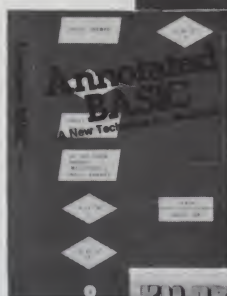
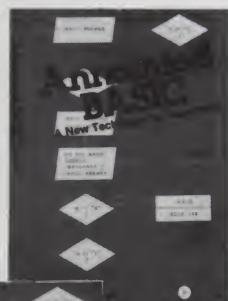
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Here is the completely updated and revised edition of the best-selling *Weather Satellite Handbook*—containing all the information on the most sophisticated spacecraft now in orbit. Dr. Taggart has written this book to serve both the experienced amateur satellite enthusiast and the newcomer. The book is an introduction to satellite watching that tells you how to construct a complete and highly effective ground station. Not just ideas, but solid hardware designs and all the instructions necessary to operate the equipment are included. An entire chapter is devoted to microcomputers and the Weather Satellite Station. And for the thousands of experimenters who are operating stations, *The New Weather Satellite Handbook* details all the procedures necessary to follow the current spacecraft.

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quire that the SAM be set up for the proper mode by writing to the control addresses in the proper pattern for the selected mode.

BASIC

Color BASIC is an 8K Microsoft BASIC which compares closely with TRS-80 Level II BASIC, with special instructions for the color, sound and joystick functions, plus a few enhancements. Since Level II is 12K BASIC and Color BASIC is only 8K, there are also some functions not present in Color BASIC. But it shouldn't be too difficult to adapt programs from one system to the other.

Missing in Color BASIC are the AUTO, TRACE and EDIT functions, which makes entering and debugging programs more difficult. Only one cassette is supported, but the cassette control takes eight-character file names and includes the SKIPF instruction, which will skip files on a cassette and go to the end of the last file on the tape to add new files. CLOADM permits loading machine-language files with an offset, if desired.

SYSTEM is replaced by EXEC (a), which allows going to a machine-lan-

guage program at address (a). PRINT USING is missing, as are the DEF functions and the error traps. In the string functions only STRING\$ is missing in Color BASIC. The nine-digit floating-point arithmetic is a compromise between Level II's six-digit single-precision and 16-digit double-precision arithmetic. Missing are all the instructions relating to defining variable types.

Most common statements are present in standard Color BASIC. Also available is Extended Color BASIC, which includes high-resolution graphics, complex sounds, extensive graphics commands, a real-time clock, program editing, user-defined functions and machine-language routines, plus most of the statements missing in Color BASIC. It costs \$99.

You can also buy several canned programs, including chess, checkers, music composing, personal finance, pinball, a diagnostic for ROM and software to convert the Color Computer to a terminal. Compatible hardware includes a printer, a telephone modem and joysticks.

RAM expansion to 16K bytes is easily done by replacing the 4K RAM

chips with 4116s and changing two jumpers clearly labeled on the board. These are available from several sources for less than \$30.

RAM expansion beyond 16K is possible but not as easy. You can get 32K by adding another set of 4116 RAMs—the problem is mostly mechanical. Obtaining 64K is possible with greater difficulty, as some software has to be changed. Kits to enable these expansions are available from Atomic City Electronics, 3195 Arizona Ave., Los Alamos, NM 87544.

Conclusions

The Color Computer is a low-cost, full-function computer suitable for most general-purpose computer use. Although limited by the restrictions of the display for some uses, it is well-suited for video games, and is easily expanded for more memory and I/O devices.

Radio Shack says they will soon offer a disk, and I know of accessories being designed at several companies. So it looks like a good start for a nice system. And the low price should mean a lot of sales, and soon, a lot of software. ■



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74LS06	25	74LS136	50	74LS275	330
74LS08	30	74LS138	75	74LS279	50
74LS09	25	74LS139	75	74LS280	195
74LS10	25	74LS145	110	74LS283	95
74LS11	30	74LS147	225	74LS290	120
74LS12	30	74LS148	125	74LS293	180
74LS13	40	74LS151	75	74LS296	100
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74LS28	35	74LS162	90	74LS353	150
74LS30	25	74LS163	90	74LS363	135
74LS32	35	74LS164	90	74LS366	90
74LS35	55	74LS166	90	74LS369	90
74LS37	50	74LS166	200	74LS367	65
74LS38	35	74LS168	170	74LS368	65
74LS40	25	74LS169	170	74LS373	115
74LS42	50	74LS170	170	74LS374	175
74LS47	75	74LS173	75	74LS375	65
74LS48	75	74LS174	90	74LS377	140
74LS49	75	74LS175	90	74LS385	185
74LS51	25	74LS181	210	74LS386	4033
74LS54	35	74LS189	95	74LS390	4034
74LS55	35	74LS190	95	74LS393	185
74LS63	120	74LS191	95	74LS395	160
74LS73	35	74LS192	80	74LS399	185
74LS74	40	74LS193	90	74LS424	295
74LS75	50	74LS194	95	74LS447	35
74LS76	40	74LS195	90	74LS490	190
74LS78	50	74LS198	80	74LS530	7500
74LS83	75	74LS197	80	74LS540	300
74LS85	110	74LS221	115	74LS541	300
74LS86	40	74LS240	115	74LS542	300
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74LS91	80	74LS242	185	74LS568	165
74LS92	65	74LS243	185	74LS569	185
74LS93	80	74LS244	100	74LS570	215
74LS95	80	74LS245	195	74LS574	910
74LS96	80	74LS247	75	74LS582	315
74LS107	40	74LS248	120	74LS583	225
74LS109	40	74LS249	95	74LS584	235
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74S05	75	74S136	105	74S251	185
74S06	45	74S139	120	74S253	740
74S09	75	74S140	140	74S257	135
74S10	65	74S151	115	74S258	145
74S11	80	74S153	115	74S260	180
74S15	65	74S157	115	74S274	1990
74S20	65	74S158	140	74S275	1990
74S22	75	74S161	280	74S280	285
74S30	45	74S162	370	74S287	470
74S32	95	74S163	370	74S288	440
74S37	185	74S166	480	74S289	695
74S38	165	74S169	540	74S301	690
74S40	40	74S174	105	74S373	340
74S51	75	74S175	105	74S374	340
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4009	45	4047	95	4508	195
4010	45	4048	75	4510	95
4011	35	4049	55	4511	95
4012	35	4050	55	4512	95
4013	45	4051	95	4514	225
4014	95	4052	95	4515	225
4015	95	4053	95	4518	150
4016	45	4055	275	4518	125
4017	95	4056	275	4519	125
4018	95	4059	995	4520	125
4019	45	4060	125	4522	125
4020	95	4066	75	4526	125
4021	95	4068	40	4527	175
4022	95	4069	40	4528	125
4023	35	4070	40	4531	95
4024	75	4071	30	4532	175
4025	35	4072	30	4539	175
4026	195	4073	30	4543	195
4027	65	4075	30	4553	495
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2732A - 2	Intel	+5	200NS	20.00
2532	Hitachi	+5	450NS	18.00

A Computer/Video Disk Combo That Really Works!

By Paul Anderson and
Everett Q. Carr

People have been waiting for a practical video disk since they were first announced by Philips and RCA almost ten years ago. Film studios saw big bucks in marketing films that had already run in the movie

houses and on TV. Computer manufacturers hoped for a cheap \$10 crash-proof archival memory consisting of a billion and a quarter bytes of ROM. Some educators believed that the video disk was a critical element

in the information technology revolution that would transform schools, maybe even eliminate them entirely.

To find out if this latter notion had any basis in fact, we built our own information transfer system. It consists of a 32K PET 2001 computer and an adapter that allows the PET to control the Pioneer video disk player (fig. 1). We have also developed software that controls the disk player. The result is that we have been able to construct an instructional program in which the student interacts with the computer and the disk on the player.

The first program is called Weather and uses an MCA-Discovision disk entitled "What Makes it Rain?" (#64-006). It costs just \$9.95. The description that follows should allow anyone interested to duplicate the system and verify our test results as an example of computer-aided video disk instruction.

The Computer/Video Disk System

The Pioneer video disk system is a superb piece of electronic and electromechanical wizardry. It uses a 1 MW HeNe gas laser to illuminate the video disk information tracks and has a 4002 internal microprocessor and a 4001 data processor for the logic and

Paul Anderson, an unpaid member of the planetarium staff, has been a student at Rensselaer Polytechnical Institute at Troy, NY. Everett Q. Carr is director of the Herkimer BOCES Planetarium (Herkimer, NY 13350) and responsible for its honors student programs and a microcomputer instructional program series that lends out computers.

Laser Illuminated/Optically Scanned

1. Pioneer of Japan
2. Pioneer Electronics of the US
Laserdisk VP-1000
3. MCA Discovision (IBM and MCA)
4. Magnavox (No Remote Control)
5. Sony of Japan
6. Philips of Holland
7. Thompson CSF of France (Disks not compatible with those of 1-6)

Software: All except Magnavox
Thompson CSF

Needle in a Groove

1. RCA
2. Zenith
3. CBS

Software: RCA

Grooveless with Needle

1. JVC of Japan
2. GE
3. Thorn/EMI of England

Software: JVC

Characteristics

All players have 1/2-hour and one-hour playing time per side, use a HeNe 1 MW gas laser, two-channel stereo (40 Hz to 20 Hz), have pushbutton controls, can operate single frame (freeze action), slow, fast forward and reverse and have picture frames numbered (1/2-hour only). The 1/2-hour versions operate at constant angular motion with disk rotating at 1800 rpm. The one-hour play time is obtained by changing disk rotation from 1800 rpm at the inside of the disk to 600 rpm at the outside of the disk, therefore operating on constant linear velocity for double play time.

Thompson CSF uses transparent information coating and system refocuses to read both disk sides without turnover. Software unknown.

The needle has a capacitor plate on its face forming a variable capacitor as a function of the disk groove variations with respect to the conductive vinyl base of the record. Needle is subject to wear and disk cannot be played continuously on a single frame. Disk grooves are 40× closer than on a hi-fi record.

Needle position is servo-controlled and tracks an information band next to the signal band. There is needle wear, and continuous play on a single track may not be feasible.

Table 1. Video disk systems comparison.

control of 25 switching functions that affect the player operations. The electromechanical system not only takes care of vertical motion in the disk rotating at 1800 rpm, but also follows individual TV picture tracks 1.6 micrometers (63 microinches) apart. A full half-hour of TV contains 54,000 TV pictures (30 frames per second \times 60 seconds per minute \times 30 minutes per half hour).

Pioneer manufactures video disk players for Discovision Associates and Magnavox. Almost 11,000 of the Discovision players have been sold to General Motors and its car dealers. In single quantity, this player costs \$3000. The big advantage is that a computer interface and connector are built-in. Another version packaged for Magnavox is supplied without an interface or remote control.

The Pioneer player with its remote control access has proved straightforward to adapt to computer control. The only exception is covered later. However, the Pioneer player is only one of four competitive video disk systems. All of them are incompatible, with differences much like those between cassette and magnetic disk recording systems of the leading manufacturers. For example, we cannot interchange tapes or disks among the three leading manufacturers. A comparison of the systems is given in Table 1. It should be obvious that the noncontact readout systems from Philips, Pioneer, Sony, Magnavox and MCA-Discovision, all of which have interchangeable disks, are superior for classroom and other instructional uses.

The chief reason for our preference of the noncontact systems is the wear-out mechanism. RCA uses a diamond stylus that contains a capacitor plate to sense signals in the record groove recorded on a 900 MHz carrier signal. The JVC scheme uses a sapphire stylus that has a capacitor plate but is servo-controlled to track signal information in a grooveless recording system. While there are no tests to confirm the data, the life of a diamond stylus is approximately 3000 hours, compared to 2000 hours for the sapphire stylus and 100,000 hours for the gas laser. The choice is therefore obvious.

But more than that, the MCA Discovision disks have each of the 30,000+ frames of "What Makes It Rain?" numbered, and they can be selected for display by remote control or with the built-in keyboard using a

numeric keypad. The internal microprocessor is programmed to allow slow motion, fast scan, variable-speed scan and single-frame indexing, all in forward or reverse motion.

It is also possible to select an individual frame by number for freeze-frame viewing. There is no wear to the disk, because there is no disk contact for readout.

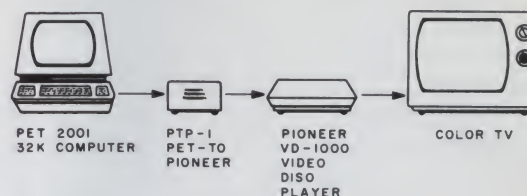


Fig. 1. A computer/video disk system.

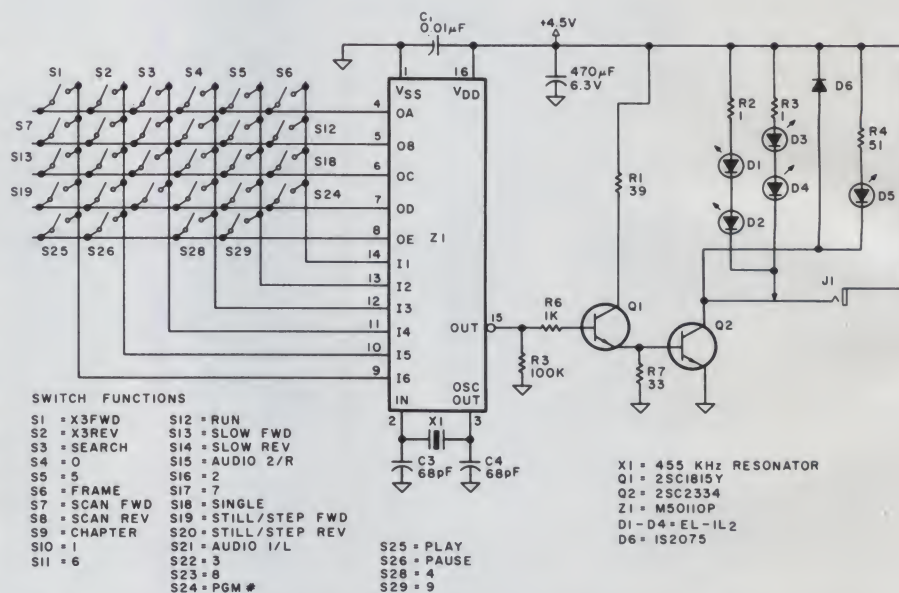


Fig. 2. RU-1000 Pioneer remote control. The switches S1 to S29 are the functional push buttons on the remote control, as the figure shows. The IC-1 appears to be a custom chip to convert switch closures to a chain of 38 kHz pulses as an output. The crystal X1 is a 455 kHz piezo-ceramic resonator, used generally in AM radio IF stages to replace IF transformers. The transistors Q1 and Q2 are a Darlington-connected line driver. The remote control can be used as a wired unit by connecting an audio connector cable to J1. The diodes D1 to D4, however, are LEDs operating at about 9400 Å, well into the infrared range. D6 is a visible region LED.

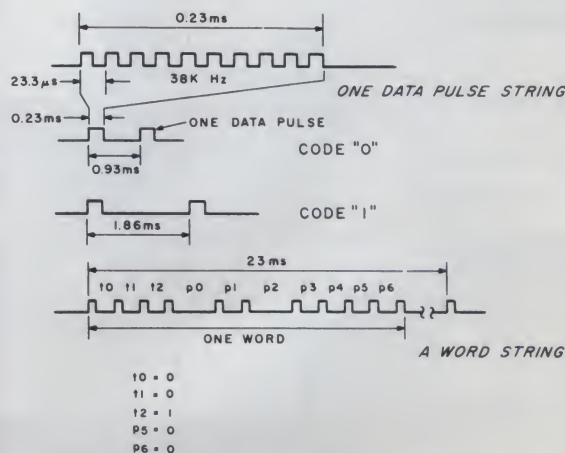


Fig. 3. Pioneer player control signals. One data pulse string is ten cycles of an approximately 38 kHz clock. The coding for a logical 0 is 0.93 ms, a short period between data pulse strings. The logical 1 is twice the logical 0 period, 1.86 ms. The word string delivered to the player is ten bits long; therefore it consists of 11 actual data pulses. Of the ten bits used, five bits are a fixed code; the remaining five bits can form up to a maximum of 32 commands.

Video Disk Adapter

Pioneer's remote control unit (RU-1000) was a parts bin for a new adapter between the PET and the disk player. The RU-1000 contains both a wired connection to control the player and an infrared wireless link. A schematic of the RU-1000 is shown in Fig. 2. IC-1 is apparently a custom MOS chip which scans the keyboard of the RU-1000 and outputs

a coded 38 kHz chain corresponding to up to 30 different switch closures. The pulse chain sequences are shown in Fig. 3.

In our adapter, the switch closures are simulated by the two CD 4051 circuits, IC-2 and IC-3, which accept the eight-bit inputs from the PET user port. The PTP-1 PET to PIONEER adapter schematic is shown in Fig. 4. The circuit board layout is given in

Fig. 5. Power for the adapter is taken from the second cassette source, which is rated for at least 200 mA; the adapter draws less than 50 mA.

The Video Disk Driver Program

The Video Disk Driver program was written to exercise a Pioneer disk player regardless of what disk is in place on the player. It allows, for example, the command to the player S1950 in response to the program query COMMAND STRING-->); the player searches for TV picture frame number 1950 and waits, with frame 1950 displayed continuously. An alternative command of S1950S would command the player to search for TV picture frame 1950 and run the play-forward from that frame.

The Weather Instruction Program

For the Discovision disk "What Makes It Rain?" we have given an interactive program, Weather, which uses some 3600 frames or about two minutes of disk play time. The brief program contains four questions from lines 1010-1260, 2020-2041, 3010-3270 and 4010-4250. In each question, the student has three possible answers. The computer responds positively to a correct answer, lets the student try again if the response is wrong or reviews the video information before trying the question again.

The review of the video is controlled by the specification of the variable Q8, and a delay loop beginning at line 13000 determines how long the player is allowed to operate. A calculation in line 13030 accounts

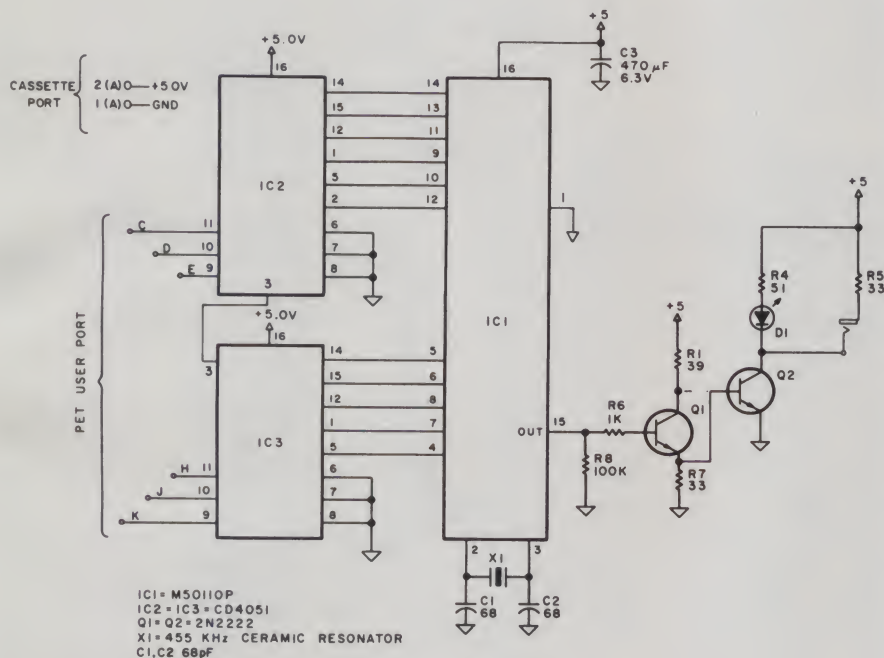
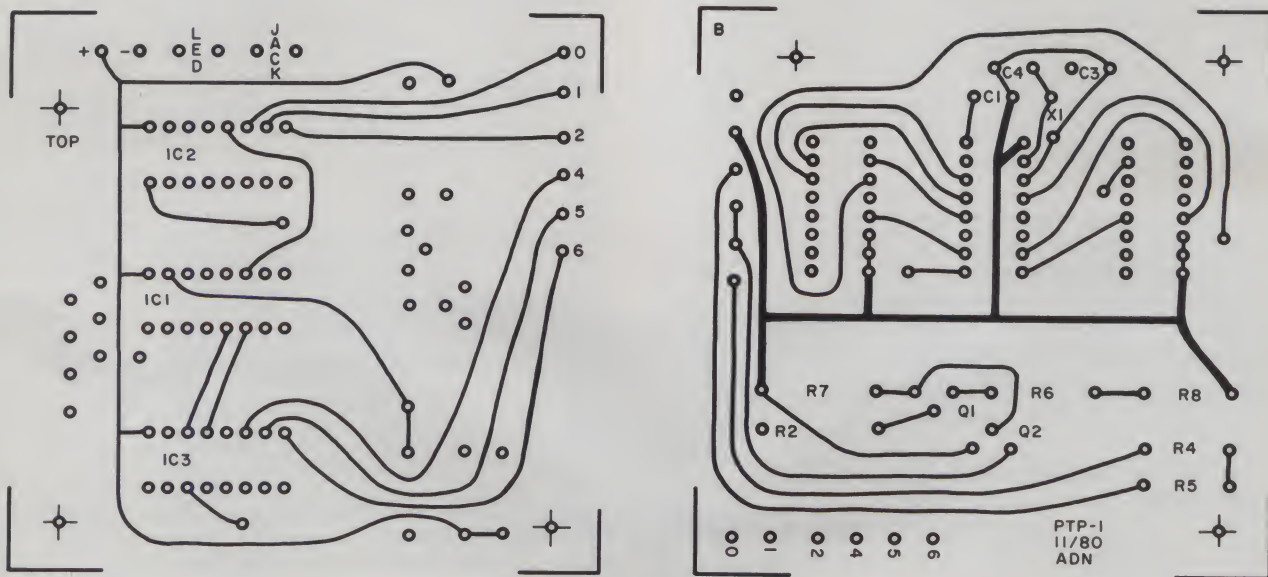
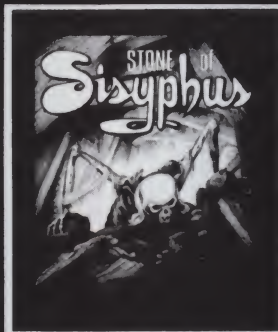
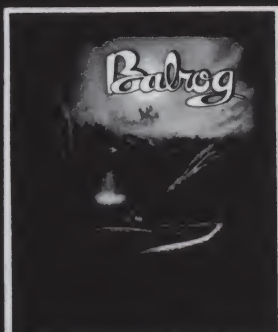


Fig. 4. PET to Pioneer adapter. In our adapter the IC-1, M50110P, was removed from the original remote control because the separate IC was not available from Pioneer. The infrared optical link was eliminated and only the wired link was used. The reason was the IR LEDs have peak current requirements of nearly 1 A, and the power we used was the PET (200 mA maximum) second cassette 5 V source. IC2 and 3 are multiplexers which, to the custom IC-1, look like switch closures which, on the input to the PET, are logical load for the user port VIA.



MACES & MAGIC

BY CHAMELEON SOFTWARE



BALROG

Meet the Chromatic Dragon face-to-flame in BALROG, the first in the MACES & MAGIC Series. This fantasy adventure features one of the largest data bases ever created for a microcomputer role playing game. Not only can you create completely individual characters, but you may also choose from a huge inventory of specific weapons and armor items. Freeform input combined with choices suggested by the program makes the discovery of the more secret areas of the dungeon a real challenge!

STONE OF SISYPHUS

The STONE OF SISYPHUS carries you to a "thinking man's" dungeon, wherein you must apply your skills to effect survival and to realize your goals. This is an unfriendly subterranean world populated by hideous monsters, and dripping with fabulous treasures — the latter enticing you to face the former! Your survival hinges upon hard intellect, as opposed to the wispy uncertainty of chance, so be prepared to draw deeply from your intellectual reservoir! And — the responsiveness of the program to the individual qualities of your character make this grand adventure frustratingly enjoyable for hundreds of hours before all of its elusive secrets can be unlocked!

MORTON'S FORK

The third entry in the Maces & Magic series, MORTON'S FORK transports you into a world bereft of natural laws — a realm populated by magical beings and strange creatures. The scenario is set within the confines of an ancient wizard's fortress. Through your keyboard input, you equip your warrior with armor, weapons, and gold, as well as with desirable personal attributes. Only then will you be able to face the dangers of MORTON'S FORK! Features include multiple skill levels and a comprehensive manual describing the colorful Maces & Magic world.

MACES & MAGIC are fantasy adventures involving you and your computer. Armed only with your wits, a microcomputer, and the software provided, you can become the hero or the meal your destiny dictates. You create a character, equip him (or her) with suitable weapons and armor, and enter the dungeon in search of fame and fortune. Neither is particularly easy to obtain.

If you are successful in avoiding or conquering the various monsters, traps, enchantments and illusions set by our nefarious dungeonmasters, you may escape with riches and glory. Your name and deeds will be recorded for posterity in the records of the dungeon. More importantly, you'll be alive. You may then use the same character in his more experienced and wealthy form when you enter dungeons on later occasions.

In each dungeon there are random events which occur, but in the vast majority of cases the skill of the player in making correct choices determine the outcome of the game. The majority of instructions are furnished within the program in the form of appropriate prompts.

There are many ways to meet an untimely demise in the dungeon. Monsters and such are just one of the lines of defense between you and the treasures stored there. Various traps await the unwary (and the wary too). Some are lethal, while others are merely unpleasant or inconvenient. It pays to be suspicious. Beware of orcs bearing gifts.

The object of the whole exercise is not just to fight the monsters and collect treasure. You have to get out alive to enjoy it. In every dungeon there is at least one exit. It is possible to escape from each and every dungeon with a whole skin. We state that fact here because players often believe this not to be true. We really aren't out to get you. Not really....

Once you successfully exit from the dungeon you will have an opportunity to save your character for further adventures in this and other dungeons. Your treasures will be converted to their gold equivalent and your weapons and armor stored in bat guano. When you start another adventure, you may call up your experienced character for another trip. The only limitation is that once a character is killed, he may re-incarnated three times; after that, he is gone forever. No second chances, no tears, no breast beating. Gone. Kaput. Finished. You will have the distinction of adding to the dungeon statistics, however. A sort of second hand immortality in recognition of a nice try. No glory or cash though. **CHARGE!!**

Maces & Magic Series

By Chameleon Software

BALROG

requires 2 drive system

TRS-80 32K DISK Model 1	012-0099	\$29.95
TRS-80 48K DISK Model 3	012-0099	\$29.95

STONE OF SISYPHUS

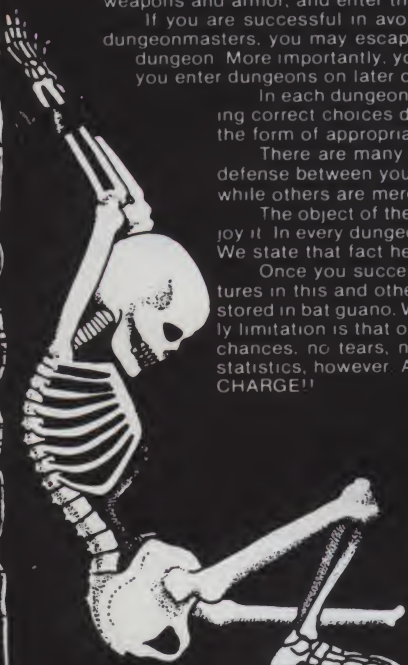
Works on 1 or 2 drive systems

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TRS-80 48K DISK Model 3	012-0100	\$29.95
ATARI 40K DISK	052-0100	\$34.95
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with Applesoft in ROM		
WORKS ON 3.2 OR 3.3	042-0100	\$29.95

MORTON'S FORK

Works on 1 or 2 drive systems

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TRS-80 48K DISK Model 3	012-0113	\$29.95
APPLE 2 PLUS or APPLE 2 - 48K		
with Applesoft in ROM		
WORKS ON 3.2 OR 3.3	042-0113	\$29.95



for search time lags that may be a function of our particular Pioneer player dynamics. We would have preferred to be able to advance the disk to a specific frame. The calculation is necessary because there is no data line available from the player which indicates the frame number. Undoubtedly, it is available internally at the microprocessor but it would be necessary to open the player and modify the circuits. The system shown seems accurate within a few frames over short time intervals. Moreover, it can be made precise with a small amount of effort.

The program uses about 15,380 bytes of RAM. It could be compressed into fewer bytes with a little effort.

We have used simple graphics that often hint to the children the correct answer. Our third-grade visitors to the planetarium seem pleased with what they see and hear. When the correct answer is given, it is reinforced visually with a printed text of the words of the disk monologue. A child will receive several reviews of new words. This is especially helpful when third-grade children are exposed for the first time to terms like

precipitation, rendezvous, evaporation and reservoirs.

Authoring a Disk Program

Authoring a disk program means a systematic approach to developing an instructional program. This, of course, involves both the video disk and the computer program. Of necessity, we did not create an original video disk. That cost was well beyond our own resources. Our project therefore involved construction of a useful computer instruction around an available disk.

Within that constraint, the major task was to use the disk player as an audiovisual editing machine with the weather disk. Both frame numbers and the monologue were recorded manually, using the disk player's regular remote control. This is a working script from which it is possible to isolate factual information, the individual concepts and principles involved. This is an iterative process. It took a half-dozen or more passes and uncounted isolated playbacks. However, we became more proficient with time.

The method we used in the computer program development was to design two program modules. The first was the Quiz Module, in a multiple choice format. The second was the Disk Driver module. The combination of the two modules is a practical approach to an authoring system using available low-cost disks and the common language resident in the popular microcomputers, BASIC.

The PET, with its user port so accessible and easy to program, is a powerful tool in this enterprise. For those not interested in a construction project, ADN Co. (62 Benedict Ave., Ilion, NY 13351) has an adapter that works with the PET. It can also be supplied for the Commodore VIC-20.

Test Results

Two groups totalling 137 third-grade students were exposed to the first two minutes of the video disk "What Makes It Rain?" Sixty-seven percent of the first class of 74 students and 72 percent of the second class of 73 answered test questions correctly. These children were attending our regular planetarium laboratory class about weather. The results were 12 percent and 14 percent higher than with a conventional teaching session consisting of a chalkboard and lecture.

The combination of computer and video disk appears to be superior to conventional methods. The work continues. We hope interested teachers will attempt to duplicate the experiments. ■

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```

1 D9=50
2 REM VIDEO DISK DRIVER WRITTEN
3 REM 10/30/80 BY PAUL D. ANDERSON
5 REM COMMAND SUMMARY AT LINES
6 REM 13000-14000
10 DIM TX(15)
20 GOSUB 12000
30 INPUT "COMMAND STRING-->";CS$
35 PRINT
40 GOSUB 10000
50 PRINT:PRINT
60 GOTO 30
10000 FOR Q1=1 TO LEN(CS$)
10010 Q2=ASC(MID$(CS$,Q1,1)):GOSUB 11000
10020 NEXT
10030 RETURN
11000 IF Q2>57 OR Q2<48 THEN 11020
11010 Q3=TX(Q2-47):GOTO 11060
11020 IF Q2>72 OR Q2<70 THEN 11040
11030 Q3=TX(Q2-59):GOTO 11060
11040 Q3=0
11045 IF Q2=80 THEN Q3=TX(14)
11050 IF Q2=83 THEN Q3=TX(15)
11060 PRINTCHR$(Q2);POKE 59471,Q3
11070 FOR J=1 TO D9 : NEXT
11080 POKE 59471,0
11090 FOR J=1 TO D9 : NEXT
11100 RETURN
12010 DATA 86,22,38,70,54,82,18,34,66
12020 DATA 50,81,52,63,53,83
12030 FOR J=1 TO 15:READ TX(J) : NEXT
12040 POKE 59459,255
12040 RETURN
13000 REM ***** COMMAND SUMMARY *****
13010 REM NUMBERS "0"-9"
13020 REM SEARCH "S"
13030 REM PAUSE "P"
13040 REM PLAY "Q" (GO)
13050 REM FRAME "F"
13060 REM STILL "H" (HALT)

```

Video Disk Driver program.

Weather interactive video disk/computer program.

```

10 GOSUB 12000 : REM INITIALIZE VIDEO
20 REM DISK STUFF
85 PRINT":POKE 59468,12
90 PRINT:PRINT:PRINT:PRINT
1000 PRINT":POKE 59468,12
1010 PRINT"
1020 PRINT"
1030 PRINT"
1040 PRINT"
1050 PRINT"
1200 PRINT"WHAT ARE CLOUDS?" :PRINT
1210 PRINT"(1) CLOUDS ARE MADE OF ICE PARTICLES" :PRINT
1220 PRINT"(2) HUGE RESERVOIRS OF"
1230 PRINT" AIRBORNE WATER" :PRINT
1240 PRINT"(3) CLOUDS ARE DUST PARTICLES"
1250 PRINT" HELD UP BY COLD AIR AND WIND." :PRINT
1260 PRINT"TYPE 1, 2 OR 3;
1270 INPUT AA
1280 IF AA=2 GOTO 1700
1290 PRINT":PRINT:PRINT:PRINT:POKE 59468,14
1300 PRINT"SORRY, THAT IS INCORRECT" :PRINT

```

More

Now with added words! * ELECTRIC MOUTH



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- Supplied with 143 letters/words/phonemes/numbers, capable of producing hundreds of words and phrases
- Expandable on-board up to thousands of words and phrases with additional speech ROMs (see new speech ROM described below)
- Four models, that plug directly into S100, Apple, Elf II and TRS-80 Level II computers
- Get ELECTRIC MOUTH to talk with either Basic or machine language (very easy to use. Complete instructions with examples included)
- Uses National Semiconductor's "Digitaler"
- Includes on-board audio amplifier and speaker, with provisions for external speakers
- Installs in just minutes.

Principle of Operation: The ELECTRIC MOUTH stores the digital equivalents of words in ROMs. When words, phrases and phonemes are desired, they simply are called for by your program and then synthesized into speech. The ELECTRIC MOUTH system requires none of your valuable memory space except for a few addresses if used in memory mapped mode. In most cases, output ports (user selectable) are used.

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one	eighteen	at	dollar	inches	number	as	c	i
two	nineteen	cancel	down	is	of	second	d	u
three	twenty	case	equal	it	off	set	e	v
four	thirty	cent	error	kilo	on	space	f	w
five	forty	400hertz tone	feel	left	out	speed	g	x
six	fifty	80hertz tone	flow	less	over	star	h	y
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i	z
eight	seventy	40ms silence	gallon	limit	percent	stop	j	
nine	eighty	80ms silence	go	low	please	than	k	
ten	ninety	160ms silence	gram	lower	plus	the	l	
eleven	hundred	320ms silence	great	mark	point	time	m	
twelve	thousand	centi	greater	meter	pound	try	n	
thirteen	million	check	have	mile	pulse	up	o	
fourteen	zero	comma	high	milli	rate	volt	p	
fifteen	again	control	higher	minute	ready	weight	q	
sixteen	ampere	danger	hour	minute	ready	a	r	
seventeen	and	degree	in	near	right	b	s	

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add	continue	fire	load	quarter	switch
adjust	copy	first	lock	range	system
alarm	correct	floor	longer	reached	temperature
alert	crease	fourth	more	receive	test
all	"de"	forward	move	record	"th"
ask	deposit	from	next	reverse	thank
assistance	dial	gas	no	red	this
attention	door	get	normal	repair	third
blue	east	going	north	repeat	turn
brake	"ed"	green	not	replace	under
button	emergency	hale	notice	room	use
buy	enter	heat	open	safe	wailing
call	entry	hello	operator	second	warning
called	"er"	help	or	secure	was
caution	"eh"	hurts	pass	select	water
celcius	evacuate	hold	per	send	went
centigrade	exit	hot	power	service	wind
change	fail	in	press	side	window
circuit	failure	incorrect	pressure	slow	yellow
cigar	fahrenheit	intruder	process	slower	yes
close	fast	key	pull	smoke	zone
cold	faster	level	push	south	

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Listing continued.

```

4010 PRINT"
4020 PRINT" SUN N\
4030 PRINT"
4040 PRINT"
4050 PRINT"
4055 PRINT"
4060 PRINT"
4070 PRINT"
4080 PRINT"
4090 PRINT"
4100 PRINT"
4200 PRINT" WHERE DOES THE WATER TO MAKE
4210 PRINT" CLOUDS COME FROM?" :PRINT
4220 PRINT" (1)THE WATER IS ALWAYS IN THE AIR":PRINT
4230 PRINT" (2)WATER EVAPORATES FROM THE OCEANS":PRINT
4240 PRINT" (3)WATER VAPOR FROM THE POLAR CAP":PRINT
4250 PRINT" TYPE 1,2 OR 3
4260 INPUT DA
4270 IF DA=2 THEN 4700
4300 PRINT"?:PRINT:PRINT:PRINT:POKE59468,14
4310 PRINT" OH DEAR,THATS WRONG. TRY AGAIN?":PRINT
4320 PRINT" TYPE YES OR NO
4330 INPUT DB$
4340 IF DB$="Y" THEN 4000
4500 PRINT"WOULD YOU LIKE TO SEE THE VIDEO AGAIN?":PRINT
4510 PRINT" TYPE YES OR NO"
4520 INPUT DC$
4530 IF DC$="N" THEN 50000
4540 CS$="S2780S":GOSUB10000:FORJ=1TO2000:NEXT
4550 CS$="G":GOSUB10000
4560 Q0=500:GOSUB13000
4610 GOT04000
4700 PRINT"?:POKE59468,14
4710 PRINT"GREAT! YOU'VE DONE IT AGAIN":FORI=0TO2000:NEXT:PRINT:PRINT:PRINT
4711 CS$="S2780S":GOSUB10000:FORJ=1TO2000:NEXT
4712 CS$="G":GOSUB10000
4714 Q0=605:GOSUB13000
4820 PRINT"FROM THE OCEANS SURFACE WATER EVAPORATES"
4830 PRINT"CONTINUOUSLY RETURNING TO THE ATMOSPHERE"
4840 FOR I=0 TO 3000:NEXT:PRINT
4850 PRINT" ....SOMETIMES FORMING CLOUDS." :FORI=0TO3000:NEXT:PRINT:PRINT
4860 PRINT" TIME LAPSE PHOTOGRAPHY ENABLES US TO":PRINT
4870 PRINT" OBSERVE THE DEVELOPMENT OF CLOUDS":PRINT
4875 PRINT" IN DETAIL." :PRINT:PRINT:PRINT
4880 FOR I=0TO4000:NEXT:PRINT
4890 PRINT"TIME TO MOVE ALONG":FORI=0TO1500:NEXT
4900 FORK=0TO5000:NEXT:GOTO85
10000 REM PARSING ROUTINE FOR CS$
10010 FOR Q1=1 TO LEN(CS$)
10020 Q2=ASC(MID$(CS$,Q1,1)):GOSUB11000
10030 NEXT
10040 RETURN
11000 IF Q2=57 OR Q2=48 THEN 11020
11010 Q3=TX(Q2-47):GOTO11060
11020 IF Q2=72 OR Q2=70 THEN 11040
11030 Q3=TX(Q2-59):GOTO11060
11040 Q3=0
11045 IF Q2=80 THEN Q3=TX(14)
11050 IF Q2=83 THEN Q3=TX(15)
11060 POKE 59471,Q3
11070 FOR J=1 TO Q3 : NEXT
11080 POKE 59471,0
11090 FOR J=1 TO Q3 : NEXT
11100 RETURN
12000 DIM TX(15)
12010 DATA 86,22,38,70,54,82,18,34,66
12020 DATA 50,81,52,69,53,83
12030 FOR J=1 TO 15 : READ TX(J) : NEXT
12040 Q9=50
12050 POKE 59459,255
12060 RETURN
13000 REM WAIT ROUTINE TO ALLOW PLAYING
13010 REM Q8 FRAMES. PICTURE THEN STOPS
13020 Q4=(Q8*2)+1
13030 IF Q4>11 THEN Q4=Q4+0,365:GOTO13030
13040 CS$="H":GOSUB10000:RETURN
13060 REM STILL "H" (HALT)
19000 D9=50
19010 DIMTX(15)
19020 GOSUB22000
19030 INPUT"COMMAND STRING-->":CS$
19035 PRINT
19040 GOSUB20000
19050 PRINT:PRINT
19060 GOT019030
20000 FOR Q1=1TOLEN(CS$)
20010 Q2=ASC(MID$(CS$,Q1,1)):GOSUB21000
20020 NEXT
20030 RETURN
21000 IF Q2=57 OR Q2=48 THEN 21020
21010 Q3=TX(Q2-47):GOTO 21060
21020 IF Q2=72 OR Q2=70 THEN 21040
21030 Q3=TX(Q2-59):GOTO21060
21040 Q3=0
21045 IFQ2=80 THEN Q3=TX(14)
21050 IFQ2=83 THEN Q3=TX(15)
21060 PRINT CHR$(Q2):POKE 59471,Q3
21070 FORJ=1 TO D9:NEXT
21080 POKE59471,0
21090 FORJ=1 TO D9:NEXT
21100 RETURN
22000 DATA 86,22,38,70,54,82,18,34,66
22010 DATA 50,81,52,69,53,83
22020 FORJ=1 TO 15:READTX(J):NEXT
22030 POKE 59459,255
22040 RETURN
23000 REM *** COMMAND SUMMARY ***
23010 REM NUMBERS "0"- "9"
23020 REM SEARCH "S"
23030 REM PAUSE "P"
23040 REM PLAY "G" (GO)
23050 REM FRAME "F"
50000 PRINT:PRINT:PRINT:PRINT" SORRY ABOUT THAT." :PRINT
50010 PRINT"MAYBE YOU WILL FEEL BETTER TOMORROW." :PRINT
50020 PRINT" BYE FOR NOW!"

```

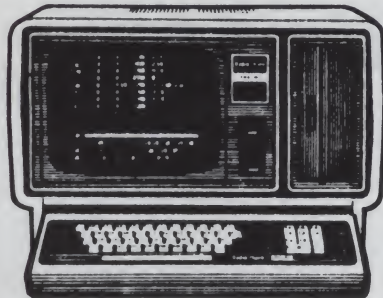

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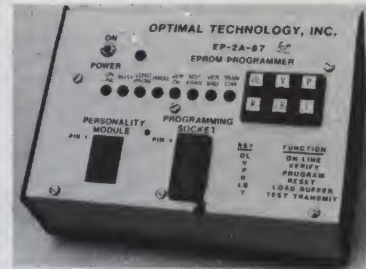
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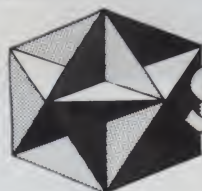
Here is how it works:

- 1) Plug in THE MILL
- 2) Run our configuration program one time
- 3) That's all

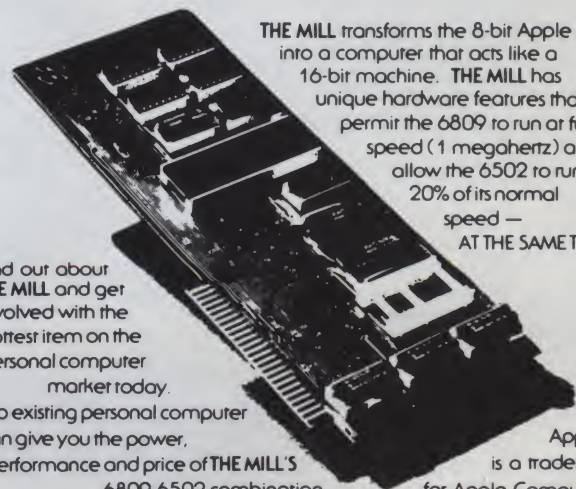
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Upgrade Your IDS Printer

By Peter E. Noeth

The Integral Data Systems IP-225 is a good dot matrix printer with graphics capability. Unfortunately, as delivered, it will not directly interface to the TRS-80 Model I line-printer port. The following circuitry will allow this interface with a minimum of effort and cost.

Basic Problem

The difficulty lies in two areas. First, the strobe pulse in the TRS-80 is only $1.5 \mu\text{s}$ long and the IP-225 requires a minimum of $4 \mu\text{s}$ pulse. Second, the acknowledge pulse occurs $100 \mu\text{s}$ after the strobe is active. The printer status routine in the TRS-80 checks for this pulse to be active approximately $35\text{--}40 \mu\text{s}$ after it outputs a character (strobe active). If it does not see an active pulse the printer routine assumes the printer is ready and outputs the next character. (See Figs. 1 and 2.)

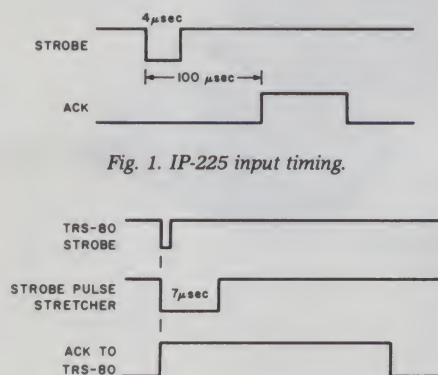


Fig. 1. IP-225 input timing.

Fig. 2. Timing activity on interface circuit.

Solution

The circuit as shown in Fig. 3 will correct the above problems. In the circuit, the 74121 is used as a pulse stretcher to provide a $7 \mu\text{s}$ strobe pulse to the printer logic board. When the strobe from the TRS-80 goes low, the set input on the 7474 forces the Q output high. This will remain until cleared. When the ACK pulse from the IP-225 returns high (printer ready), it clocks the D input, which is tied low, and resets the Q output low. The result of this action provides an ACK active pulse to the TRS-80 as soon as the strobe is active, so no delay is evident to the printer status routine in the TRS-80 and no characters will be lost.

Interconnection

I built my circuit on a two-inch-

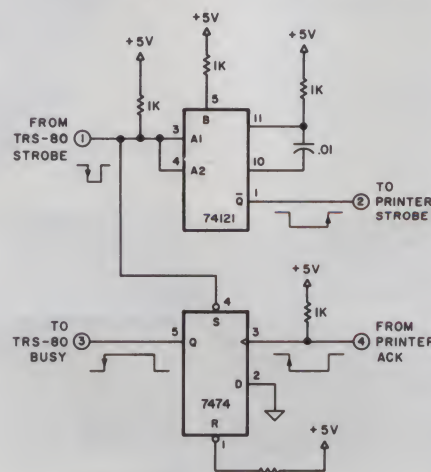


Fig. 3. IP-225 interface circuit.

square piece of perfboard using sockets for the two integrated circuits. I insulated the underside of the board with a piece of light cardboard and mounted it to the support between the transformer and the printer logic board on the bottom side of the IP-225, using RTV adhesive. This position allows you to break the leads coming from the printer logic board to the 25-pin interface connector on the back of the IP-225 to insert the new interface board. I also ran two wires from the ground and 5V power bus on the printer logic board to provide the required power for the new interface. (See Fig. 4 for the connections.)

Although I designed this interface for the IP-225, it also could be used with any parallel I/O printer to be interfaced to the TRS-80 that does not meet the as-originally-designed timing requirements of the strobe and acknowledge pulses. ■

Address correspondence to Peter E. Noeth, 6906 Lenwood Way, San Jose, CA 95120.

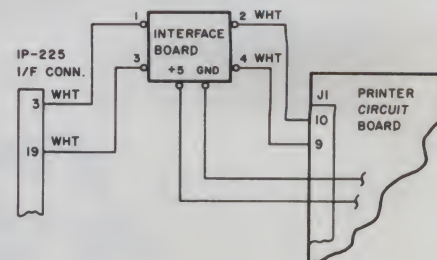


Fig. 4. Interface board interconnection.

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6	BREAKEYN	Break-even analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queuing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model

NAME	DESCRIPTION
53 FQEOWSH	As above but with shortages permitted
54 FQEQQPB	As above but with quantity price breaks
55 QUEUECB	Cost-benefit waiting line analysis
56 NCFANAL	Net cash-flow analysis for simple investment
57 PROFIND	Profitability index of a project
58 CAP1	Cap. Asset Pr. Model analysis of project

59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUID	DOVE business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
99	RRCONVBD	Investor's rate of return on convertible bond
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Spotlight on the Starwriter

By Mark J. Borgerson

If you can wait a minute, we can save you \$1000," claims C. Itoh about its Starwriter printer. But how much is a minute? After connecting my new Starwriter to my Apple II, I decided to find out.

I printed a page of text on the Starwriter, and then printed the same text on a Qume. The result: the Qume (\$3415) took 123 seconds, while the Starwriter (\$2230) took 173 seconds. The Starwriter, then, took about 42 percent longer than the Qume.

In a large office, where speed is important to efficiency, the extra print-out time might not be worth the savings. But as a consultant and freelance writer, I can always find something to do while the printer cranks out my latest manuscript. I can also find a lot of things to do with \$1185.

Two Steps

The engineers at C. Itoh took two steps to achieve the \$1000 price reduction. First, they replaced the expensive and complicated servo drive mechanism that Qume, NEC and Diablo printers use to position the printhead with a high-resolution stepping motor. The motor's limited stepping speed is probably responsible, at least in part, for the lower

print speed of the Starwriter. Second, they used an 8085 microprocessor as a system controller and minimized the complexity of the printer's electronics.

As far as I can tell, they cut no corners in the mechanical assembly of the printer. The case is cast-aluminum, well-covered inside with sound-deadening foam. The printer frame is a hefty aluminum casting, and the bearings, guide rails and cables controlling the printhead all seem comparable in quality to the more expensive daisywheel printers.

My printer came with a standard Centronics parallel interface. An RS-232 serial interface is also available as an option. The printer is plug-compatible with a number of inter-

faces for the Apple—I chose the Epson interface (generally sold with the Epson MX-80) because it costs about \$90 less than the Apple Centronics interface. The Epson card is completely hardware- and software-compatible with the Apple interface.

The Starwriter has several internal switches which allow you to select operating modes for the printer. A toggle switch inside the front cover lets you select ten or 12 characters per inch. The standard printer is equipped with a ten-pitch Courier print wheel. (The printer uses the widely-available Diablo print wheels and ribbons.) A set of DIP switches inside the rear cover control functions such as default form length and auto line-feed.

```
@b      Bold-Face Print can be used
        to accent words.

@-      Underlining also makes words
        stand out.

@u, @d  These commands give super and subscripts.

@sl0,20,30. This sets tab stops at columns
           10,20 and 30.

@t      This command moves the print head to
        the next tab stop.
```

Example 1.

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1624 NW Kings Blvd., Corvallis, OR 97330.*



The Starwriter/Starwriter II daisywheel printer.

One of the most important option switches controls the printer mode. This switch has two positions: serial mode and line mode. In the line mode, the printer will not print any characters until the full line is received. The printer will then print bidirectionally and use logic-seeking to minimize printhead movement. Sequences of space characters are converted to a single, continuous head movement. This mode is about 17 percent faster than the serial mode (I used the serial mode in the print speed comparison), but the printer will respond to only a few special commands.

In the serial mode, the printer responds to all the Qume control sequences, but prints unidirectionally. This cuts the print speed, but lets you use the reverse line-feed, tabbing and direct carriage control features the same as you would with a Qume. Since a lot of word processing software uses these features, you will probably want to use this mode most of the time. If however, you plan to do a lot of long program listings, the line mode may appeal to you.

Example 1 shows some of the special features available in the Qume

emulation mode. It's a portion of the demonstration text provided with a software package I wrote called Stardriver, which extends the capabilities of the Apple-Writer word processor to let you include special print mode commands in your text.

Only One Problem

In the first six weeks that I owned Starwriter, I printed a number of short articles and two drafts of a 150-page book. With one small exception, the printer performed flawlessly. The exception had to do with the paper advance motor: the stepper motor which drives the platen and tractor feed is a little less powerful than I would like. At one time it stalled under load and caused several lines to overprint. I discovered that this is only a problem with heavy paper. The paper guide puts the paper under tension by running it between a metal plate and several foam pressure pads. The combination of heavy paper, friction and the weight of the paper (which sits in a box on the floor) was too much for the motor. I removed the paper guide (which I didn't need anyway) and have had no problems since.

A second problem might arise if

you intend to implement a graphics program that uses extensive forward and reverse paper movements. The Starwriter tractor feed grips the paper only after it passes the platen. The Qume tractor, on the other hand, grips the paper both before and after it goes around the platen. This means that the Qume actually pulls the paper back when doing reverse line feeds. The Starwriter tractor will only pull the paper forward. Reverse movements depend on the platen friction. Thus, a possible registration problem may arise if you try multiple reverse paper movements.

Conclusion

If you can tolerate the loss in printer throughput and want to save a thousand dollars or more, take a close look at the Starwriter from C. Itoh. It is a well-designed, ruggedly constructed printer with a number of nice features. Among the most important of these is the printer's ability to imitate the Qume printer in applications where the special control codes of the Qume are employed. The printer also uses Diablo print wheels and ribbons, which are available through computer stores and office supply outlets in most cities. ■

Letter-Quality Printer For the Budget-Minded

By William L. Colsher

The C. Itoh Starwriter has been a reliable and easy-to-use printer for my Apple III system, and I recommend it to anyone who needs letter-quality output on a budget.

I bought an Apple III back in December of 1980, primarily for word processing. The dealer warned me that the software would not be available for some time, but I went ahead with the purchase so I could become familiar with the system as quickly as

possible. I decided to forego a printer until Word Painter, Apple's word processor, came to market.

I soon discovered the power of VisiCalc III and Business Basic, and almost as quickly realized that I still needed a printer. What good is a VisiCalc back order report if you can't print it out?

Since I planned to use the Apple III for word processing, it seemed sensible to purchase a letter-quality printer. Apple distributes the Qume, but I felt that it was a little high-powered (and expensive) for my needs. A little research turned up the C. Itoh Starwriter. At a price about \$1000 less than the other letter-quality printers on the market, it looked like the machine for me.

Naturally, something had to be sacrificed for that much money. My Starwriter prints at 25 characters per second, roughly half the speed of the more costly machines. But for my purposes, time is not critical.

The Starwriter is a massive unit. It weighs 19.5 kilos—almost 43 pounds. A look inside the housing reveals the reason: the mechanism is supported by a massive die-cast aluminum frame. This printer is solid.

Since the Apple III does not yet have a parallel printer interface card, connecting the Starwriter was not quite the plug-it-in-and-print operation it often is with Centronics-type machines. Further, since the Apple III does nearly everything with software, getting the built-in serial port

Transmission Speed

BPS	S1	S2
2400	open	open*
1200	closed	open
600	open	closed
300	closed	closed

Parity	S5	S6
even	open	open
odd	open	closed*
none	closed	open

Character Length	S3
7 Bits	closed*
8 bits	open

Stop Bits	S8
1	closed*
2	open

*Indicates factory setting.

Table 1. Printer settings. (From C. Itoh Electronics' Starwriter User's Manual, pp. 4-5.)



My Apple III and a C. Itoh Starwriter, being checked out at my dealer. Note the size of the printer relative to the 12-inch monitor and the Apple.

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1711 Robin Lane, Lisle, IL 60532.

to talk with the outside world involves more than flipping a couple of switches to set the data rate.

The Apple III serial port is configured as data terminal equipment (DTE). This allows the Apple III to function with the correct software as a smart terminal. Since a printer is also a DTE device, you need a modem eliminator, which is simply a short piece of cable that connects the pin the Apple III is sending on to the pin the printer expects to receive data on. Without the modem eliminator, the Apple III would send data on the

same pin that the printer is trying to send data on—something like two deaf and blind people talking to each other.

Apple supplies a modem eliminator with each Apple III, so the wiring is simple. Plug the eliminator into the Apple and then plug the printer cable into the other end of the modem eliminator.

As I mentioned earlier, the Apple III uses software to control operation. There are no DIP switches to set the data rate and format. Instead, there is a device driver. All of the Ap-

ple III's input-output operations are handled by these routines. This allows enormous freedom in writing applications programs, since all devices look the same to the program (e.g., by calling a disk driver ".PRINTER" your 10M Winchester can be used to spool printed output for later physical printing).

In order to alter a device driver, use a program called the System Configuration Program (SCP) that is supplied on the Apple III utilities disk.

I personally dislike poking around

In addition to the usual capabilities one expects from any printer, the Starwriter has a number of interesting features that add considerably to its versatility. For example, by transmitting the sequence: ESC D, the Starwriter will feed back down!

It is also possible to set the vertical spacing in 1/48 inch increments and the carrier pitch in 1/120 inch increments. By using these commands it is possible to use this machine as a graphics printer...



```
PRINT#1;CHR$(27);'E02';CHR$(27);'L01'
pi=3.14159
FOR theta=0 TO 2*pi STEP (1/24)
  tabfactor=INT(SIN(theta)*48)+100
  PRINT#1; TAB(tabfactor);'.'
NEXT theta
```

Sample 1. Printout showing Starwriter's sub- and superscript abilities.

Value 1—Data Rate

Value	Speed
03	110 baud (Teletype speed)
04	134.5 baud (Selectric speed)
06	300 baud (normal telecommunications speed)
07	600 baud
08	1200 baud (normal printer speed)
09	1800 baud
0A	2400 baud (C. Itoh printer speed)
0C	4800 baud
0E	9600 baud

Value 2—Data Format

Value	Format
22	7 bits, odd parity
26	7 bits, even parity
2A	7 bits, mark parity
2E	7 bits, space parity
00	8 bits, no parity
42	6 bits, odd parity
46	6 bits, even parity
4A	6 bits, mark parity
4E	6 bits, space parity

Table 2. Apple III .PRINTER control values. (Tables from Apple III Standard Device Drivers.)

1. Boot the Apple III using the System Utilities disk.
2. Select option 3—System Configuration Program (SCP).
3. Select SCP function 1—add a driver file.
4. Place the disk with the driver file you want to alter in disk drive 2. If you have only one disk drive, remove the System Utilities disk and use that disk drive. (Be sure to substitute ".D1" for ".D2" when it appears below.)
5. In response to the prompt "enter driver file name:" type: .d1/sos.driver and press return.
6. Press return when the file has loaded to go back to the SCP menu.
7. Select SCP function 3—edit driver parameters.
8. Enter the number of the ".PRINTER" driver when the program asks for it.
9. Select item 5—configuration block data—when you are asked for a number.
10. Use the cursor keys to move the box to the value you want to alter.
11. Press return when you have made all the changes you want.
12. Press return to leave the edit driver parameters screen.
13. Press return to leave the select driver to be edited screen.
14. Select SCP function 5—generate new system.
15. Enter a new driver file name; for example, .d2/new.driver.
16. When the new driver file has been written, press return to go back to the SCP menu.
17. Select option 7—Quit.
18. Select option 4—Quit.
19. Reboot the Apple III with the disk containing your new driver file. In Business Basic:


```
UNLOCK SOS.DRIVER (return)
RENAME SOS.DRIVER,OLD.DRIVER (return)
RENAME NEW.DRIVER,SOS.DRIVER (return)
```

 When you boot using that disk you will be using your new drivers.

Table 3. Changing a device driver.

in hardware with lots of moving parts. For me, the simplest course was to alter the device driver to agree with what my new printer expects. Table 3 shows the procedure for changing a driver. As you can see from Table 2, Apple has allowed for just about any printer that uses RS-232C interfacing. Just a few key-strokes and you're ready to print.

After setting up the new device and connecting the printer, I was ready to check it all out. So after booting Business Basic I opened the ".PRINTER" file and sent out a print command. Nothing happened. I checked the cables. (There are no screws on the eliminator cable to hold it, the Apple III and the printer cable together: one of Apple's few oversights with this machine!)

After considerable head-scratching, I discovered the rather unusual "paper-out" mechanism on the Starwriter. It's incorporated into the paper feed rack rather than into the platen support, as on my Epson MX-80. I put the paper in correctly and printed out "test...test...test" a few times, and then began to explore some of the other capabilities of my new machine.

I had expected a very basic printer for my money, but I soon found that the Starwriter has some interesting capabilities. Table 4 lists the various control codes available on the Starwriter. The most interesting are the vertical and horizontal spacing controls.

Sample 1 shows some of the things that I've learned to do so far. I expect

to make good use of the super- and subscribing feature, particularly if Apple brings out a graphing package for use with this type printer. You can do some pretty fair plotting on the Starwriter. Apple has a plotting

package for the old Apple II that uses the Qume printer in much the same manner. If control codes are universal, as implied in the Starwriter manual, it should be easy to adapt the existing code to the Apple III. ■

Starwriter at a Glance

Printing Speed	25 characters per second
Horizontal Spacing	1/120 inch min.
Vertical Spacing	1/48 inch min.
Carriage return time	1 second
Line feed time	40 msec (1/6 inch)
Paper width	381 mm maximum
Number of copies	3
Font	Diablo plastic wheel compatible
Power	90-127 VAC, 50/60 Hz, 70 W
Dimensions	625 mm wide, 380 mm deep, 258 mm high
Weight	19.5 kg

Address: C. Itoh Electronics, 5301 Beethoven St., Los Angeles, CA 90066.

Code

Function

FF	Form feed
ESC D	Half line feed down
ESC U	Half line feed up
ESC SP	Printing
ESC 1	Set horizontal tab 1 to present position
ESC 2	Clear all H tabs
ESC 9	Left margin set
ESC 0	Right margin set
ESC L (d1) (d2)	vertical spacing set in 1/48-inch increments
ESC E (d1) (d2)	horizontal space set in 1/120-inch increments
ESC ((list)	Tab set list where list is of the form d1d2... to a maximum of 16 locations.
	Tabs are absolute
ESC SUB I	Reset

Table 4. Printer control codes. (From Starwriter User's Manual.)

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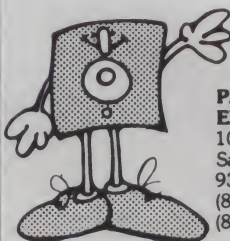
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- Serial shift registers
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A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer.

Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.

79-295A	\$69.95 Assembled
79-295K	\$59.95 Kit
79-295B	\$19.95 Bareboard

SPEECH SYNTHESIZERS

JBE's Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. it requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.

Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.

81-088 Apple II Speech Synthesizer	\$139.95
81-120 Parallel Input Speech Synthesizer	\$149.95
Prices include the SC-01 Chip SC-01 sold separately for \$ 75.95	

EPROM EXPANSION CARD

JBE EPROM Expander for the Apple II holds six 5V 2716's for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.

81-085A Asm.	\$59.95
81-085K Kit	\$49.95
81-085B Bare Board	\$39.95

81-260 "SLIM"

Single board large scale integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM®, SYM®, and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.

- 6502 MPU
- Two 6522 VIA's
- Four 2114 RAM's (2K bytes)
- One EPROM 2516 or 2532
- Crystal clock 1 Mhz
- Requires 5V 1AMP Power
- 4.5 x 6.5 card
- Power on reset
- Fully buffered-expandable
- Solder mask-both sides

Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.

Prices:	
81-260A	\$199.95 Assembled
81-260K	\$149.95 Kit
81-260B	\$ 39.95 Bare Board

6502 MICROCOMPUTER

6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

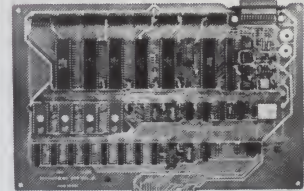
80-153 Asm.	\$110.95
80-153K Kit	\$ 89.95
80-153 Bare Board	\$ 19.95

Z-80 MICROCOMPUTER

Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Asm.	\$129.95
80-280K Kit	\$119.95
80-280 Bare Board	\$ 19.95

JBE I MICROCOMPUTER

JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 8 2114 RAM (4K)
- 2 2716 EPROM (Monitor & Tiny Basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with Monitor)

Both versions include sockets for 2716's or 2532's, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)

This board also features power on reset and cassette interface.

81-030 C Fully Populated	\$349.95
81-030M Partially Populated	\$249.95
81-030B Bare Board	\$ 89.95
2716 EPROM (with Monitor)	\$ 19.95
2715 EPROM (with Tiny Basic)	\$ 19.95

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Expand Your Horizon

By Patrick Corry

It should be easy! Many intriguing projects begin with this thought. So it was when we decided to transfer a BASIC program from a time-shared minicomputer to our North Star Horizon microcomputer.

Of course, I knew that there are several dialects of BASIC, many of which are customized for a specific environment. But in some cases editing problems are minimal. For example, Hewlett-Packard BASIC and North Star BASIC are similar.

We planned to move the program without retyping. The time-shared system listed a program. Then we promptly shifted the connector from the acoustic coupler to the console port of the Horizon. After waiting an

appropriate time we connected the terminal to the Horizon and tried to list the acquired text. Surprisingly, nothing had been received! Since then the mystery has been solved.

We have written a program which enables the operator of the Horizon's terminal to conveniently:

- Exchange data with information networks and computerized bulletin boards

- Store data received in program-mable random-access memory (RAM) or on disk for subsequent display, transmission or printout

- Download programs transmitted by remote time-share computers or other personal computers.

- Edit text by means of a BASIC program

- Cause BASIC to accept a sequence of ASCII characters contained in RAM as an input program.

There are three categories of problems associated with our method of data transfer.

The Connection Problem

According to the widely-used RS-232C convention, both computers and modems transmit data on line 3 of the connecting cable. They both receive data on line 2. Therefore, the connecting cable between the Horizon's second serial port and the acoustic coupler must cross-connect lines 2 and 3.

A direct solution is to buy or make a crossover cable (see Fig. 1). Another solution is to wire a switch to the motherboard of the Horizon which will let you change the status of the second serial port between modem and terminal modes. If you select the latter option, consult the hardware manual (HRZ-D, p.72) supplied with your Horizon.

The Timing Problem

Most systems with which we communicate exchange data at the rate of 300 bits per second (bps)—about 30 characters per second. Therefore after accepting a character from the modem the Horizon must be ready to receive the next character after a delay of no more than 1/30 of a second. Within this allotted time the received character must be processed and transmitted to the terminal for dis-



Fig. 1. Crossover cable. Use 25 pin connectors.

To specify operation of both serial ports with one stop bit and a seven-bit code we modified DOS 5.2 (origin zero) as follows:

1. Boot DOS and type LF DOS 4000
2. Type GO M0E00 and use the DS command to change the bytes at 4892 (hexadecimal) and 4896 from EC to 7A
3. Type OS to return to DOS
4. Type SF DOS 4000
5. Reboot DOS

Table 1. Stop bit modification of North Star DOS 5.2.

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play. Since our terminal also operates at 300 bps, it requires 1/30 of a second after receiving one character before it can accept the next.

The consequences of these timing constraints are illustrated in Fig. 2. As shown, the terminal must accept characters at least as fast as the remote source sends them. Otherwise, characters will not only be absent from the display but also will not be stored in the Horizon! Therefore, it is critical that the Horizon send characters to the terminal using the minimum number of stop bits.

The DOS supplied with the Horizon can be easily personalized to send one stop bit. All that is needed is to change two bytes of DOS 5.2 from EC (hexadecimal) to 7A. See Table 1 for specific instructions. If your terminal operates at a higher data rate than that of the remote (sending) computer, this modification should not be necessary. In any case, the Horizon must not use too much time before sending received characters to the terminal. The fastest procedure is to have the Horizon simply store the character in a RAM buffer and immediately transmit the character to the terminal. The NSCOM program, which is written in BASIC, uses machine-language subroutines to achieve the speed necessary for this procedure (see Listing 1).

The Software Problem

For communication with an external source we connect the data cables as shown in Fig. 3. In addition, special software is needed to allow the Horizon to simultaneously accept input from two sources. Furthermore, we want the capability of storing part or all of the communicated data. If the data is the text of a program it should be accessible to the North Star interpreter. These operations are selected by input to the BASIC program, NSCOM. The relevant command menu is given in Table 2.

Our solution is to partition the available RAM space by use of the **MEMSET** command so that the directing program, NSCOM, and the stored communications may coexist. (See Table 3.) The upper limit of space available to NSCOM is chosen to yield the maximum room in memory for the ramfile. This limit was found by experimentation and is defined by the variable M in the second line of NSCOM. The start of the ramfile is labeled S and satisfies $S = M + 50$.

Communication: This command allows full duplex communication between the console terminal and a computer or modem connected to the Horizon's second serial port.

Display: The contents of the ramfile is listed on the console terminal. Control C may be used to stop the listing.

Echo: The contents of the ramfile is transmitted out the second serial port by means of a subroutine called ECHO. This subroutine will only transmit a character after the preceding character has been echoed back by the remote system. A control "C" entered at the console will abort the transfer and invoke the communication mode.

Feed: This command causes the set of ASCII characters stored in the ramfile to be sent to the BASIC interpreter which is cold-started.

Garbage removal: This command calls a machine-language subroutine which writes nulls over any sequence of characters in the ramfile that are not bounded by a number and a carriage return.

Kill: The end of file marker is filled in the first cell of the ramfile. Therefore new data will be written over previously received data.

Load: A request is sent to the DOS to load

into RAM the diskfile whose name is input. The usual DOS naming conventions and responses are observed.

Message: This command will send the message specified by the data in the third line of NSCOM to the second serial port. In the DATA line, control characters are indicated by a leading "+" sign. For example, a carriage return is specified by a "+M". See Appendix 4 of the North Star Software Manual for the control codes. At the completion of the message the communication mode is entered.

Print: The contents of the ramfile is sent out the second serial port. Use a standard data cable to connect this port to a printer. Alternatively the ramfile could be sent out a parallel port if one is implemented.

Save: A request is sent to DOS to save the ramfile on diskette. The usual DOS naming conventions and responses are observed.

Unkill: The command negates the effect of the kill command by replacing the character at the first cell of the ramfile.

Where?: The end of the ramfile and the highest available RAM address are found. The user should not attempt to store data beyond this address.

NOTE: A disk directory may be obtained by typing a 1 or a 2 depending on the drive of interest.

Table 2. NSCOM commands—type only the first letter.

Listing 1.

```

1 REM -> NSCOM BY PATRICK CORRY - 9/2/81
5 IF EXAM(95)<>237 THEN CHAIN "SETUP" \ REM->VERIFY INITIALIZATION OF USR'S
10 DATA " +M SIGN-ON MESSAGE +M"
15 W1=237/C1=100/F1=44/G1=0/D1=50/Z1=211\REM->USR STARTS
20 M=21000 \ REM->ADDRESS OF HIGHEST BYTE AVAILABLE TO BASIC
30 S=M+50 \REM->S IS THE START OF THE RAMFILE (S= 21050=523AHX)
35 REM->RESERVE 50 BYTES FOR DOS COMMANDS
40 DIM M$(50)
50 IF EXAM(3593)+256*EXAM(3594)=M THEN 80
60 !"PLEASE MEMSET TO ",M," AND RUN AGAIN"\END \ REM->ALLOW ROOM FOR RAMFILE
80 IF Q9=0 THEN 920 \ REM->CHECK FOR AVAILABLE RAM
90 IF FREE(0) > 75 THEN 100 \ ! ! ! ****RUN AGAIN**** \END
100 !FREE(0)
110 !" COMMAND",
120 INPUT C$
130 IF C$="S" THEN 410
140 IF C$="K" THEN 1070
150 IF C$="U" THEN 1090
170 IF C$="F" THEN 580
180 IF C$="C" THEN 300
190 IF C$="P" THEN 680
200 IF C$="L" THEN 410
220 IF C$="M" THEN 800
230 IF C$="D" THEN 680
240 IF C$="W" THEN 920
250 IF C$="G" THEN 1060
255 !" C$="1" THEN 1100 \ IF C$="2" THEN 1100
257 IF C$="E" THEN 1200
260 !"(C)OMMUNICATE OR (D)ISPLAY OR (F)EED "
265 !"OR (G)ARBAGE REMOVAL OR (K)ILL OR (L)OAD OR"
270 !"(M)ESSAGE OR (S)AVE OR (P)RINT OR (W)HERE OR (1) OR (2)"
290 GOTO 90
299 REM-> COMMUNICATIONS MODE
300 E=CALL(W1,S) \ REM->FIND CURRENT END OF RAMFILE
310 !"CURRENT END OF RAMFILE ",E
320 !"COMMUNICATION MODE"\ E1=E
330 E=CALL(C1,E)
350 IF E=E1 THEN 370
360 IF E<>C1 THEN 380
370 !"NO EXTERNAL DATA FILED IN RAM."
380 \ !"NEXT BYTE AT ",E
390 GOTO 90
400 REM-> CREATE DISK IMAGE OF RAMFILE OR LOAD RAMFILE FROM DISK
410 IF C$>"L" THEN 440 \REM-> C$ IS "L" OR "S"
420 !"LOAD RAM FROM WHICH DISK", \GOTO 480
440 E=CALL(W1,S)
450 B= INT((E-S+1)/256)+1 \ REM->CALCULATE # OF BLOCKS
460 !"SAVE RAMFILE ENDING AT ",E," IN WHICH DISK",
480 !"FILE",\INPUT F$ \ IF C$="L" THEN 510
490 CREATE F$,B,10

```

More →

The end of the ramfile is the first address which holds the value 06. These definitions result in 50 bytes of free space which can be used to store commands issued to North Star DOS 5.2. By use of this command buffer we have dramatically reduced the time needed to save and load files. Programmers should note that this technique can be applied to give DOS a sequence of commands in a more general context.

How to Set Up NSCOM

To use the unmodified version of NSCOM given here you need a computer running North Star DOS 5.2 with origin 0000 (hexadecimal) and BASIC with origin 0E00. Also required is a minimum of 24K bytes of continuous RAM starting at zero and two serial ports addressed in the standard manner. The user subroutines called occupy memory locations 0 to 255.

To enter NSCOM and its satellite machine-language routines you must type and save two BASIC programs: NSCOM and SETUP (see Listings 1 and 2). When SETUP is run the machine-language routines are filled into RAM starting at address 0000, and a chain to NSCOM is executed. When you type NSCOM you may omit the REM statements since they are not destinations for branch statements.

The boundaries of NSCOM, the command buffer, and the ramfile may be changed by modifying lines 20 and 510 of NSCOM. You should redefine M in line 20 and the command string in line 510. These changes will allow you to increase the size of the ramfile if you shrink BASIC or use floating-point BASIC. The command string must contain the value of S expressed in hexadecimal notation. A useful modification for users having parallel printers is to change the device code in line 720. Users of single-density systems should modify line 450.

How to Use NSCOM

NSCOM has three modes of operation: command, communication and storage. After SETUP is completed the command mode is entered. As shown in Table 2, the C command will invoke the communication mode. In this mode two-way communication with an external source is possible. Two control characters have special meaning. Control Q will cause a return to the command mode and Control F will invoke the storage

Listing 1 continued.

```

510 M$=C$+F "F$+" 523A"+CHR$(13)\ REM->DOS COMMAND STRING
515 REM->M+1 IS THE START OF THE COMMAND BUFFER
520 FOR J=1 TO LEN(M$)\FILL M+J,ASC(M$(J,J))\NEXT J
530 FILL M+J,06\ REM->END OF COMMAND MARKER
540 FILL 65,40\FILL 66,01\REM->MODIFY USR TO JUMP TO DOS
550 Q=CALL(D1,M+1)\REM->SEND DOS COMMAND
560 FILL 65,0\FILL 66,14\ REM->REPLACE JUMP TO BASIC COLD START
570 GOTO 90
580 REM-> FEEDER RESETS MEMSET TO Q9 AND COLD STARTS BASIC
600 FOR J= 95 TO 98\FILL J,0\NEXT J\ REM->MODIFY USR TO COLD START BASIC
605 FILL 3598,165\ REM->SET MAXIMUM LINE LENGTH
610 E=CALL(W1,S)
620 !"FEEDING BASIC RAM FROM ",S+1," TO ",E
625 !"REMOVE GARBAGE FIRST",\INPUT F$
630 IF F$="NO" THEN 650
640 Q=CALL(G1,S)\REM-> REMOVE GARBAGE
650 Q=CALL(F1,S+1)\ REM->FEEDS BASIC RAMFILE -NO RETURN
670 REM->DISPLAY AND PRINT COMMANDS-
680 E=CALL(W1,S)
690 ERRSET 90,Q,Q\REM->TO CONTINUE PROGRAM ON CONTROL C
700 FOR J= S+1 TO E
710 IF C$ <> "P" THEN 730
720 !1,CHR$(EXAM(J)),\REM->MOD. DEVICE CODE FOR PAR. PRINTERS
730 !CHR$(EXAM(J)),
740 NEXT J
750 ERRSET\ GOTO 90
800 REM->MESSAGE DATA AT 3RD LINE
810 READ M$ !"MESSAGE:"
820 FOR J=1 TO LEN(M$)
830 IF M$(J,J) <> "+" THEN 850
840 J=J+1\X=ASC(M$(J,J))-64\GOTO 860
850 X=ASC(M$(J,J))
860 !1,CHR$(X),\! CHR$(X),
870 IF X<>13 THEN 890
880 FOR K=1 TO 3000\NEXTK\! \ REM->TIME LOOP FOR REMOTE COMPUTER
890 NEXT J
900 GOTO 300\ REM-> ENTER COMMUNICATION MODE
910 REM-> FINDS THE END OF THE RAMFILE-
920 E=CALL(W1,S)
930 !"THE END OF THE RAMFILE IS ",E
940 REM->FIND THE HIGHEST ADDRESS OF THE CONTIGUOUS RAM
950 IF Q9<>0 THEN 1020
960 J=41\ Z9=EXAM(S+1)
970 J=J+1\ Q=J*512-1\IF Q < S THEN 970
980 Z=EXAM(Q)\ FILL Q,6
990 IF EXAM(Q)<>6 THEN 1010
1000 FILL Q,Z\ GOTO 970
1010 Q9=Q-512
1015 Q8=INT(Q9/256)\FILL 46,Q8\FILL 45,Q9-256*Q8\REM->PREPARE MEMSET FOR FEEDER
1020 !"SPACE REMAINING: ",Q9-E
1030 FILL Q9,6\ REM->PLACE ENDMARK FOR SAFETY
1040 !"HIGHEST AVAILABLE RAM ADDRESS: ",Q9
1050 GOTO 90
1060 Q=CALL(G1,S)\ GOTO 90\REM-> USR TO NULLOUT GARBAGE CHARACTERS
1070 !"RESTARTING RAMFILE"
1080 Z9=EXAM(S+1)\FILLS+1,6\GOTO 90\ REM->KILL-NEW DATA OVERWRITES RAMFILE
1090 FILL S+1,Z9\ GOTO 90\ REM->UNKILL- CONTINUES RAMFILE
1100 M$= "I"+C$+CHR$(13)+CHR$(13)+CHR$(13)\REM->CREATE DOS COMMAND
1110 GOTO 520
1199 REM -> INITIALIZE FOR ECHO ROUTINE-
1200 FILL 65,Z1\ FILL 66,0
1205 Q=CALL(D1,S+1)
1207 FILL 65,0\FILL 66,14\ REM->REPLACE JUMP TO BASIC COLD START
1210 !\GOTO 300

```

```

5 REM-> SETUP FOR NSCOM - PATRICK CORRY 9/2/81
10 FOR J=0 TO 244
20 READ X
30 FILL J,X
40 NEXT J
50 CHAIN "NSCOM"
100 DATA 235,006,000,035,126,254,006,200,203,064,032,022,254,013
110 DATA 040,243,254,010,040,239,254,058,242,040,000,254,048,250
120 DATA 040,000,006,255,024,225,254,013,032,221,024,217,054,000
130 DATA 024,215,033,255,191,034,009,014,237,083,250,000,033,067
140 DATA 000,034,017,001,237,115,252,000,195,000,014,034,254,000
150 DATA 042,250,000,126,254,006,040,008,035,034,250,000,042,254
160 DATA 000,201,033,080,010,034,017,001,042,254,000,237,123,252
170 DATA 000,201,235,205,062,010,032,014,219,002,230,127,254,017
180 DATA 200,254,006,040,035,205,132,000,205,070,010,032,232,219
190 DATA 004,205,142,000,024,225,245,205,120,010,032,251,241,211
200 DATA 004,201,245,205,112,010,032,251,241,211,002,201,062,060
210 DATA 205,142,000,062,013,205,132,000,219,003,230,002,040,017
220 DATA 219,002,230,127,254,018,032,009,054,006,062,062,205,142
230 DATA 000,024,172,219,005,230,002,040,227,219,004,230,127,119
240 DATA 190,032,006,035,205,142,000,024,213,043,054,006,195,004
250 DATA 014,205,067,000,205,132,000,205,070,010,040,008,205,241
260 DATA 010,202,086,000,024,243,219,004,205,142,000,024,230,235
270 DATA 035,126,254,006,032,250,201

```

Listing 2.

4MHZ, DOUBLE DENSITY, COLOR & B/W GRAPHICS . . THE LNW80 COMPUTER



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PROCESSOR	4.0 MHZ	1.8 MHZ	2.0 MHZ
LEVEL II BASIC INTERP.	YES	YES	LEVEL III BASIC
TRS80 MODEL 1 LEVEL II COMPATIBLE	YES	YES	NO
48K BYTES RAM	YES	YES	YES
CASSETTE BAUD RATE	500/1000	500	500/1500
FLOPPY DISK CONTROLLER	SINGLE/ DOUBLE	SINGLE	SINGLE/ DOUBLE
SERIAL RS232 PORT	YES	YES	YES
PRINTER PORT	YES	YES	YES
REAL TIME CLOCK	YES	YES	YES
24 X 80 CHARACTERS	YES	NO	NO
VIDEO MONITOR	YES	YES	YES
UPPER AND LOWER CASE	YES	OPTIONAL	YES
REVERSE VIDEO	YES	NO	NO
KEYBOARD	63 KEY	53 KEY	53 KEY
NUMERIC KEY PAD	YES	NO	YES
B/W GRAPHICS, 128 X 48	YES	YES	YES
HI-RESOLUTION B/W GRAPHICS, 480 X 192	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (NTSC), 128 X 192 IN 8 COLORS	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (RGB), 384 X 192 IN 8 COLORS	OPTIONAL	NO	NO
WARRANTY	6 MONTHS	90 DAYS	90 DAYS
TOTAL SYSTEM PRICE	\$1,914.00	\$1,840.00	\$2,187.00
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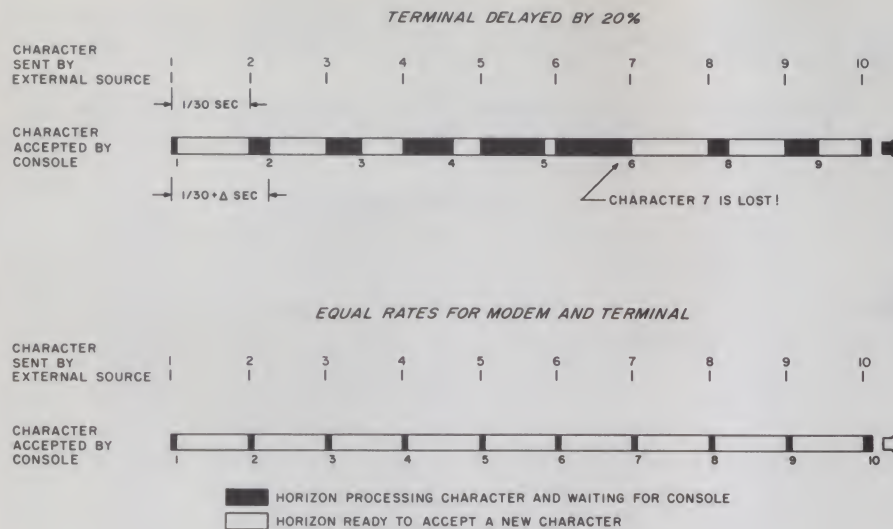


Fig. 2. Delay exaggerated for illustration.

```

10 REM->CHANGES ALL SINGLE QUOTAION MARKS, CHR$(39)
20 REM-> TO DOUBLE QUOTATION MARKS, CHR$(34)
30 PRINT " RAMFILE START", \INPUT S
40 S=S+1
50 IF EXAM(S)=6 THEN END
60 IF EXAM(S)=39 THEN FILL S,34
70 GOTO 40

```

Listing 3.

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mode. In the storage mode all characters received from the external source are stored in the ramfile. Now the only special character recognized is control-R, which causes a return to the communication mode. Although the user is responsible for not entering too large a ramfile, a warning is given when data is lost. This overflow condition is indicated by an uninitiated jump from storage to command mode (see Fig. 4).

In a work session with NSCOM you might take these steps:

1. Load and run SETUP.
2. The K command is used to re-start the ramfile.
3. The C command is used to enter the communication mode.
4. Log on to a remote system and a BASIC program is fetched.
5. The LIST command is typed and terminated with a control F instead of the usual carriage return. The console will display an open bracket and a carriage return will be transmitted.
6. After the listing is completed a Control R is typed to return to communication mode. You may log off the remote system at this time.

7. A Control Q is typed to return to command mode.

8. The Save command is used to store the ramfile on diskette (a precaution).

9. The Feed command is used to send the ramfile to the BASIC interpreter.

10. The program is edited and saved using the utilities of North Star BASIC.

In another session you could log on to an information network such as The Source or Compuserve and search for data. After the desired data is located, it could be simultaneously listed on the terminal and stored in the Horizon's RAM. Later it could be saved on disk and printed.

The Feed command allows the BASIC interpreter to process a sequence of ASCII characters stored in RAM in the same way that a stream of characters coming from a terminal is handled. Therefore you can manipulate a program text while it is stored in RAM using BASIC programs. You can use this feature to do specialized editing. For example, all single quotation marks can be converted to double (see Listing 3). You can also create a series of DATA lines from the contents of memory. The data lines in the setup program were obtained by use of the program in Listing 4.

How NSCOM Works

The BASIC program NSCOM calculates and partitions the available RAM, prints prompts and status information and manipulates ramfiles. The files may be saved on disk, listed on the terminal, or transmitted out the second serial port. NSCOM calls five machine-language subroutines: GARBAGE NULLING (Listing 5), FEEDER, COMMUNICATION MODE, and ECHO (Listing 6) and EOT? (Listing 7). GARBAGE NULLING will write null characters over any character in the ramfile which is not surrounded by a number and a carriage return.

FEEDER is used to send commands to DOS, programs to BASIC, or characters to the ECHO subroutine. Accordingly NSCOM must modify the FEEDER subroutine. The initialization process for FEEDER changes the character-in call used by DOS 5.2. Characters are now obtained from RAM instead of the console port. Depending on which entry point to FEEDER is used the characters are sent either to DOS, to ECHO or to a cold-started BASIC. Communication mode alternately checks the two serial ports and sends characters received from one port to the other port. Upon receipt of a control-F, a jump is made to a routine which consecutively fills RAM with the characters entering the second serial port. It may be possible to upload the text contained in the ramfile to an external computer by use of the E command, which calls the ECHO subroutine. This routine transmits the ramfile out the second serial port with the constraint that the echo of a character must be received before the next character is sent. The effectiveness of this simple handshaking depends upon the software of the remote computer. The subroutine EOT? finds the address of the first cell of the ramfile that holds a value of 06 (the endmark). This address is

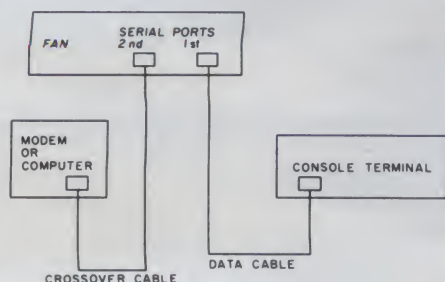


Fig. 3. Horizon back view.

See List of Advertisers on page 178

Hexadecimal

0000-00FF	Machine-language subroutines
0100-0DFF	DOS 5.2
0E00-421D	BASIC (unshrunk)
421E-5208	NSCOM
5209-5239	Command Buffer
523A-RAMtop	Ramfile

Decimal

0-255
256-3583
3584-16925
176926-21000
21001-21049
21050-RAMtop

Table 3. Memory map—NSCOM standard configuration.

```

10 REM>= CREATES RAMFILE WITH ASCII DATA LINES FROM RAM CONTENTS
15 D$=" DATA "
20 S=21050\ A=S
30 !"START OF USR, END OF USR",\INPUT W,U
35 IF N= 0 THEN 80\ REM -> N COUNTS ITEMS PER DATA LINE
40 REM ->GET NEXT BYTE
50 B=EXAM(W)\GOSUB 110\ N=N+1
55 W=W+1\IF W=U+1 THEN 105
60 IF N= 20 THEN 80
70 A=A+1\ FILL A , ASC(",")\GOTO40
80 A=A+1\FILL A,13\A=A+1\FILL A,10
85 L=L+1\B=L\GOSUB 110
90 FOR K= 1 TO 6\FILL A+K,ASC(D$(K,K))\ NEXT K
100 A=A+6\N=1\ GOTO 40
105 FILL A+1,13\FILL A+2,6\ END
110 REM->A=NEXT AVAILABLE ADDRESS\ B=BYTE VALUE
130 A=A+1\FILL A,INT(B/100)+48\B=B-100*INT(B/100)
150 A=A+1\FILL A,INT(B/10)+48\B=B-10*INT(B/10)
160 A=A+1\FILL A,B+48\ RETURN
  
```

Listing 4.

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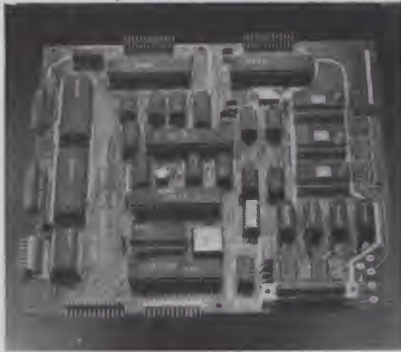
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placed in the HL register pair and passed back to NSCOM. Note that NSCOM uses the DE register pair when passing an address to the subroutines.

As mentioned, NSCOM also modifies the FEEDER routine when sending commands to DOS. Without this modification FEEDER would cold-start BASIC and allow it to use all the available RAM. When any BASIC program is running, the utilization of RAM is limited by the MEMSET command. This limitation will preserve the ramfile even if NSCOM is scratched and another BASIC program entered. Therefore you may stop NSCOM, load and run your own program, and then reload NSCOM without disturbing the ramfile. At the completion of a session of NSCOM use, BASIC should be cold-started in order to utilize all the available RAM.

Under development are procedures which allow the BASIC editing commands to be used on the text stored in the ramfile. A version of NSCOM which does not use the locations 0-255 is nearing completion. Improvements can be made in the software handshaking in the Message and Echo commands. The amount of space available for the ramfile can be increased by separating those com-

mands which are only used once from NSCOM. These routines would be saved as a BASIC program which could be chained to from NSCOM.

Further streamlining can be achieved by removing REMS and spaces from NSCOM which were included to improve legibility. We are developing the capability of transmitting a break signal used by some remote systems. The ramfile could serve as an input buffer or be used for rapid sorting without disk access delays. Also to be explored are applications of NSCOM's facility for giving DOS and BASIC a sequence of commands without operator intervention.

An enhanced version of NSCOM on double-density disk will be commercially available. The hardware supplied with your Horizon allows for many communication options. I have enjoyed developing some relevant software. ■

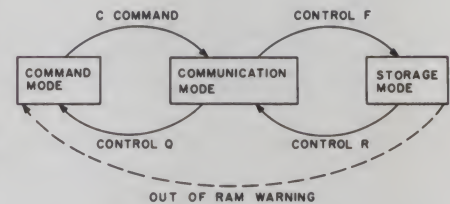


Fig. 4.

```

                                TITLE GARBAGE NULLING
                                ;REMOVES GARBAGE FROM RAMFILE
                                ;DE PASSED FROM NSCOM WITH START RAMFILE
0010      .RADIX 16
          .Z80
          .PHASE 00H
0000      EX DE,HL              ;USE HL AS POINTER
0001      LD B,00H              ;FLAG RESET - NOT IN BASIC LINE
0003      INC HL                 ;POINT TO NEXT BYTE
0004      LD A,(HL)              ;GET CHAR
0005      CP 06H                 ;IS IT THE EOT MARKER?
0007      RET Z                  ;IF SO RETURN TO NSCOM
0008      BIT 0,B                ;IF IN LINE LOOK FOR CR
000A      JR NZ,EOL?             ;CR OK
000C      CP 0DH                 ;LF OK
000E      JR Z,COUNT
0010      CP 0AH
0012      JR Z,COUNT
0014      CP 3AH ;>'9'?
0016      JP P,REPLACE
0018      CP 30H ;<'0'?
001E      JP M,REPLACE
0020      LD B,0FFH              ;SET FLAG - IN BASIC LINE
0022      JR COUNT
0024      CP 0DH ;CR INDICATES END OF LINE
0026      JR NZ,COUNT
0028      JR RESET               ;IT WAS THE EOL!
002A      REPLACE:LD(HL),00H      ;REPLACE GARBAGE WITH NULL
          JR COUNT
          .DEPHASE

```

Listing 5.

```

                                Listing 6.
                                TITLE NSCOM SUBROUTINES FOR DOS 5.2
                                ;AUG. 15,1981 - P. CORRY
0010      .PHASE 002CH
          .RADIX 16
          .Z80
00FA      STPOINT EQU 0FAH        ;TO HOLD RAM POINTER
00FC      STSP EQU 0FCH           ;TO HOLD STACK POINTER
00FE      STLH EQU 0FEH           ;TO HOLD HL
0A50      NORMAL EQU 0A50H        ;NORMAL IS DOS CHARIN ROUTINE START
BFFF      MEMSET EQU 0BFFFH       ;48K? NSCOM MODIFIES AS NEEDED
0E09      HIMEM EQU 0E09H         ;BASIC'S SCRATCHPAD FOR HIMEM
0111      VECT EQU 0111H          ;VECT HOLDS ADDR CURRENT INPUT ROUTINE START

```

Listing 6.

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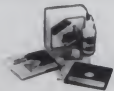


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Listing 6 continued.

```

0E04      21 BFFF
0E05      22 0E09
0A3E      ED 53 00FA
0A46      21 00A3
0A70      22 0111
0A78      ED 73 00FC
002C      C3 0E0D
002F      22 00FE
0032      2A 00FA
0036      22 0111
0039      22 0111
003C      ED 73 00FC
0040      C3 0E0D
0043      22 00FE
0046      2A 00FA
0049      7E
004A      FE 06
004C      28 08
004E      23
004F      22 00FA
0052      2A 00FE
0055      C9
0056      21 0A50
0059      22 0111
005C      2A 00FE
005F      ED 7B 00FC
0063      C9

0064      EB
0065      CD 0A3E
0068      20 0E
006A      DB 02
006C      E6 7F
006E      FE 11
0070      C8
0071      FE 06
0073      28 23
0075      CD 0084
0078      CD 0A46
007B      20 0E
007D      DB 04
007F      CD 008E
0082      18 E1
0084      F5
0085      CD 0A78
0088      20 FB
008A      F1
008B      D3 04
008D      C9
008E      F5
008F      CD 0A70
0092      20 FB
0094      F1
0096      D3 02
0097      C9

0098      3E 3C
009A      CD 008E
009D      3E 0D
009F      CD 0084
00A2      DB 03
00A4      E6 02
00A6      28 11
00A8      DB 02
00AA      E6 7F
00AC      FE 12
00AE      20 09
00B0      36 06
00B2      3E 3E
00B4      CD 008E
00B7      18 AC

00B9      DB 05
00BD      E6 02
00BD      28 E3
00BF      DB 04
00C1      E6 7F
00C3      77
00C4      BE
00C5      20 06
00C7      23
00C8      CD 008E
00CB      18 D5
00CD      2B
00CE      36 06
00D0      C3 0E04

00D3      CD 00A3
00D6      CD 0084
00D9      CD 0A46
00DC      28 08
00DE      CD 0AF1
00E1      CA 0056
00E4      18 F3
00E6      DB 04
00E8      CD 008E
00EB      18 E6

WARM EQU 0E04 ;BASIC'S WARM START
COLD EQU 0E00 ;BASIC'S COLD START
ISTO EQU 0A3EH ;DOS 5.2 STATUS ROUTINES
IST1 EQU 0A46H
OSTO EQU 0A70H
OST1 EQU 0A0A7BH
;FEEDER ROUTINE
INITD: LD HL, MEMSET ;HL=MEMSET FOR NEW BASIC
LD (HIMEM), HL ;SET MEMSIZE FOR NEW BASIC
LD (STPOINT), DE ;DE PASSED FROM NSCOM - START RAMFILE
INIT: LD HL, FEEDER ;HL = START OF FEEDER INPUT ROUTINE
LD (VECT), HL ;CURRENT INPUT ROUTINE IS NOW FEEDER
LD (STSP), SP ;SAVE BASIC'S STACK POINTER
JP COLD ;NSCOM WILL OVERWRITE THIS ADDR FOR DOS COMMANDS
FEEDER: LD (STHL), HL ;SAVE BASIC'S HL
LD HL, (STPOINT) ;HL POINTS TO NEXT CHAR
LD A, (HL) ;GET CHAR
CP 06
JR Z, RESTOR ;IF EOT THEN RESTORE VECT TO DOS CHARIN
INC HL ;INCREMENT RAM POINTER
LD (STPOINT), HL ;STORE ADDRESS NEXT CHAR
LD HL, (STHL) ;RETRIEVE BASIC'S OR DOS HL
RET ;GO BACK TO BASIC OR DOS
RESTOR: LD HL, NORMAL ;HL = ADDRESS NORMAL IN ROUTINE
LD (VECT), HL ;CURRENT IN ROUTINE IS NOW NORMAL
LD HL, (STHL) ;RETRIEVE BASIC'S HL
LD SP, (STSP) ;RETRIEVE BASIC'S STACK POINTER
RET ;RETURN IN CONTROL TO NSCOM OR BASIC
PAGE 60
;NSCOM - COMMUNICATION MODE
;DE PASSED FROM NSCOM WITH START OF RAMFILE
TALK: EX DE, HL ;INIT HL AS POINTER
LOOKCON: CALL ISTO
JR NZ, LOOKEXT ;IF NO CHAR LOOK AT SECOND PORT
JR A, (02) ;GET CONSOLE CHAR.
AND 7FH
CP 11H ;"Q" -> BACK TO NSCOM
RET Z ;BACK TO COMMAND MODE OF NSCOM
CP 06H ;"F" -> ENTER STORAGE MODE
JR Z, INITFIL ;STORE COMMUNICATION IN RAMFILE
CALL SENDXT ;OTHERWISE SEND CHAR
LOOKEXT: CALL IST1
JR NZ, LOOKCON ;IF NOT LOOK AT CONSOLE
IN A, (04) ;GET EXT. CHAR.
CALL SENDCON ;LOOK AT CONSOLE AGAIN
SENDXT: PUSH AF
WAITXT: CALL OST1
JR NZ, WAITEXT
POP AF ;RETRIEVE CHAR.
OUT (04), A
RET
SENDCON: PUSH AF ;SAVE CHAR.
WAITCON: CALL OSTO
JR NZ, WAITCON
POP AF ;RETRIEVE CHAR.
OUT (02), A ;SEND CHAR.
RET
PAGE 60
INITFIL: LD A, 3CH ;A="C"
CALL SENDCON ;SHOW "C" FOR STORAGE MODE
LD A, 0DH ;A="CR"
CALL SENDXT ;SEND CR
STOPFIL?: IN A, (03) ;CHECK CONSOLE
AND 02
JR Z, FILLRAM ;IF NO CHAR INPUT CONTINUE STORAGE MODE
IN A, (02)
AND 7FH
CP 12H ;IS CHAR A CONTROL R?
JR NZ, FILLRAM ;IF NOT CONTINUE FILLING RAM
LD (HL), 06 ;WRITE EOF MARKER
LD A, 3E ;A=">"
CALL SENDCON ;CONTINUE TALK MODE
JR LOOKCON ;STORAGE MODE FOR NSCOM
;THE FOLLOWING STORES COM IN RAM UNTIL "R FROM CONSOLE
FILLRAM: IN A, (05) ;GET STATUS BYTE
AND 02
JR Z, STOPFIL? ;IF NOTHING THERE LOOK AT CONSOLE
IN A, (04) ;GET CHAR FROM SECOND PORT.
AND 7FH
LD (HL), A ;STORE CHAR AT HL LOCATION
CP (HL) ;VERIFY CHAR STORED
JR NZ, WARN ;IF OUT OF RAM WARN
INC HL ;INCREASE RAM POINTER
CALL SENDCON ;DISPLAY CHAR
JR STOPFIL?
WARN: DEC HL ;SET HL TO EOT
LD (HL), 06 ;WRITE EOT MARKER
JP WARM ;WARN USER BY STARTING BASIC
;ECHO ROUTINE
ECHO: CALL FEEDER ;GET CHAR AND CHECK FOR END OF RAMFILE
CALL SENDXT ;SEND CHAR TO REMOTE SYSTEM
ECHOLOOK: CALL IST1 ;LOOK FOR ECHO
JR Z, RECEIVE ;IF READY SHOW CHAR
CALL 0AF1H ;CHECK CONSOLE FOR "C"
JP Z, RESTOR ;WAIT FOR ECHO
JR ECHOLOO
RECEIVE: IN A, (04) ;SHOW CHAR
CALL SENDCON
JR ECHO
DEPHASE

```

```

0010      .RADIX 16
          .280
00EE      EB ;THIS ROUTINE RELOCATES
00EF      23 ;HL=DE=RAMFILE START
00F0      7E
00F1      FE 06
00F3      20 FA
00F5      C9

TITLE EOT
;FIND EOT MARKER:06H
;DE=START ADDRESS FROM NSCOM

```

Listing 7.

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321B7

The Sorcerer Reveals Hidden Commands

By C. Kevin McCabe

The Exidy Sorcerer hides processing routines for 14 monitor commands deep within its 2716 PROMs. With a few waves of the Sorcerer's magic wand, a majority of these commands can also be used without change within BASIC programs.

Along with other operations, there are monitor routines to:

- configure the Sorcerer's input/output by selection of appropriate monitor- or user-supplied drivers;
- load, move, inspect, save and execute machine code and data;
- test RAM memory bit-by-bit; and

- specify prompt characters and tape header information.

Each of these commands can be specified in a BASIC string variable, along with any necessary or optional parameters, as shown in Table 1. The utility subroutines in Listing 1 place the command string into the monitor's input buffer, then call the appropriate command processor via BASIC's USR statement. On completion of the command—which might change an output driver, obtain data from the keyboard or execute a machine-language routine in RAM—control

jumps back to the BASIC program.

The result is full control over I/O processing and many other monitor functions within BASIC programs. A related benefit arises from use of standard monitor commands and parameters, making the BASIC software nearly self-documenting.

To understand this bit of Sorcerer magic, let's take a closer look at the monitor's organization. In addition to the 4K of PROM beginning at E000H, the top 176 (B0H) bytes of RAM are dedicated to the monitor. The upper 111 (6FH) bytes of this area serve as a scratchpad RAM work area.

Assume that MRAM is the lowest address in this 111 byte RAM work area. What's hidden at MRAM and the following bytes? Lots of goodies! There are bytes to specify I/O driver routine addresses, tape header information, cassette tape and motor status, output delay and input prompt and cursor location. Whenever a monitor command requires such information to perform its function, or changes one of the parameters, the appropriate RAM location in the work area is read or updated.

Certainly, a BASIC program could PEEK and POKE about in the work area to change I/O devices, for example—but that's the hard way. Even

Address	Command	Function
E4D3	DU XXXX [YYYY]	Display contents of memory.
E538	EN XXXX	Load hex byte into memory.
E597	GO XXXX	Execute program at XXXX.
E78A	LO [name] [U] [XXXX]	Load file from tape U.
E562	MO XXXX YYYY [S] [ZZZZ]	Copy memory block-to-block
E845	PR = X	Change to specified prompt.
E638	SA [name] XXXX YYYY [U]	Save memory on tape U.
E5A2	SE F = XX	Set file type header byte.
	I = K	Input from keyboard.
	= P	Input from parallel port
	= S	Input from serial port.
	= XXXX	Input via driver at XXXX.
	O = L	Output to Centronics
	= P	Output to parallel port
	= S	Output to serial port
	= V	Output to video screen
	= XXXX	Output via driver at XXXX.
	S = XX	Set display delay to XX.
	T = X	Data rate = 300 [X = 1], 1200 [0].
	X = XXXX	Set autoexecute address.

Table 1. Sorcerer monitor commands.

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worse, that method is almost incomprehensible within a BASIC program. The BASIC statements POKE MRAM + 63,147: POKE MRAM + 64,233 may select the Centronics output driver, but they don't convey that meaning to the programmer as readily as the monitor's equivalent SET 0=L command.

A Better Way

There must be a better way—and there is. The secret lies in the 60 bytes beginning at MRAM which form the monitor's input buffer. When keys are struck following a monitor prompt, the ASCII value of each input character is placed left-justified in the buffer. A carriage return (13 decimal, or 0DH) terminates the monitor's input routine.

A portion of the warm start processor WARM checks the first two bytes in the buffer against a PROM table containing the command characters. If a match is found, the monitor jumps to the associated command processor code and executes the command. If there's no match, an error message is output instead. In either event, a return address is first pushed onto the stack; all processor and error routines end with a Z-80 return command, which pulls the address from the stack and makes an unconditional jump back into WARM.

But why use the keyboard to enter commands? A BASIC program can easily poke ASCII values into the input buffer. Lines 30000-30030 in Listing 1 take the string specified by CMD\$ and place it, along with an added carriage return character, in the input buffer beginning at MRAM. So far, so good—but there are two possible hitches.

The first problem is finding the elusive MRAM; since the work area lies at the top of installed memory, MRAM varies from Sorcerer to Sorcerer. However, the monitor provides a machine-independent solution. On each cold start, the monitor tests memory locations for usability, beginning at location 0000H. When the first unusable location is found (by failure of a location to receive and hold a test value) the monitor assumes that it has exceeded installed memory. An address counter is decremented by one, then the resulting 16-bit address is stored at 0F000-0F001H. As is usual with Z-80 operations, the low-order byte is stored in the lower location.

Lines 40000-40030 in Listing 1 cal-

culate MRAM by PEEKs to those locations. For systems with more than 32K of installed memory, the subroutine also converts the resulting decimal address to the necessary negative form.

Ideally, the monitor's own parser in the WARM routine would be used to identify and execute the command poked into the buffer. The second possible hitch comes from the behavior of the monitor after execution of the command. To be useful in a BASIC program, the monitor commands should execute and then return control to BASIC. However, entry into the command processors through WARM causes a return to WARM, not BASIC.

The solution is BASIC's USR command, which executes the machine code at a specified address, then returns control to BASIC. The two bytes at 260-261 (104-105H) are used as a jump vector to the address of the desired code routine. A call to USR jumps to the specified code and begins execution; when a return is encountered, BASIC regains control.

Summary

That gives the final ingredient to the Sorcerer's brew. In addition to the text of the desired monitor command, the program uses another

string with the appropriate processor address from Table 1. Lines 10000-20020 convert the four digits of a hex address string to decimal, and POKE them into the two-byte USR hook.

Mixed together, these ingredients provide easy BASIC control of monitor functions. MRAM is found by an initial call to line 40000. The desired monitor function is specified by an equate to the string CMD\$; the address of the desired processor is equated to CP\$. A call to line 20000 converts and shifts the strings to the proper locations, transfers control to the processor, then retakes command on completion. Additional monitor commands can follow, if desired.

Listing 2 illustrates use of this process. Notably, the program logic is clear even without the remark statements. The first 256 bytes of memory are output to the Centronics printer, then saved at 300 bits per second on tape unit 1. New values are input to the same area of memory from tape unit 2, at 1200 bits per second. Those values—which must terminate with a Z-80 return command of 0C9H—are executed, and control returns to BASIC for the final video message.

All that with only a few equates and subroutine calls—and it's nearly self-documenting to boot. That's powerful magic from your Sorcerer! ■

```

10000 REM--Convert hex address byte to decimal equivalent
10010 VHI = ASC(LEFT$(HEX$,1))-48: IF VHI>9 THEN VHI = VHI-7
10020 VLO = ASC(RIGHT$(HEX$,1))-48: IF VLO>9 THEN VLO = VLO-7
10030 VDEC = 16 * VHI + VLO: RETURN
20000 REM--Poke hex address equivalent into USR hook
20010 HEX$ = LEFT$(CP$,2): GOSUB 10000: POKE 261, VDEC
20020 HEX$ = RIGHT$(CP$,2): GOSUB 10000: POKE 260, VDEC
30000 REM--Poke monitor command into monitor RAM & execute it
30010 CMD$ = CMD$+CHR$(13): FOR J=0 TO LEN(CMD$)-1
30020 POKE J+MRAM, ASC(MID$(CMD$,J+1,1)): NEXT J
30030 J = USR(J): RETURN
40000 REM--Locate first byte of monitor work area
40010 MRAM = 256 * PEEK(-4095) + PEEK(-4096)
40020 IF MRAM > 32767 THEN MRAM = MRAM - 65536
40030 MRAM = MRAM - 110: RETURN

```

Listing 1. Utility subroutines.

```

100 REM--Example program (requires use of Listing 1 routine)
110 GOSUB 40000: REM--Find MRAM = location of input buffer
120 CMD$="SE 0=L": CP$="E5A2": GOSUB 20000: REM--Centronics out
130 CMD$="DU 0 FF": CP$="E4D3": GOSUB 20000: REM--Dump memory
140 CMD$="SE 0=V": CP$="E5A2": GOSUB 20000: REM--Video out
150 CMD$="SE T=1": GOSUB 20000: CMD$="SA XAMPL 0 FF"
160 CP$="E638": GOSUB 20000: REM--Save memory at 300 baud
170 CMD$="SE T=0": CP$="E5A2": GOSUB 20000: REM--Set 1200 baud
180 CMD$="LO 2 0 FF": CP$="E78A": GOSUB 20000: REM--Load memory
190 CMD$="GO 0": CP$="E597": GOSUB 20000: REM--Execute code
200 PRINT "Tha..tha..tha..that's all, folks!": END

```

Listing 2. Example program.

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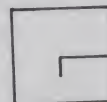
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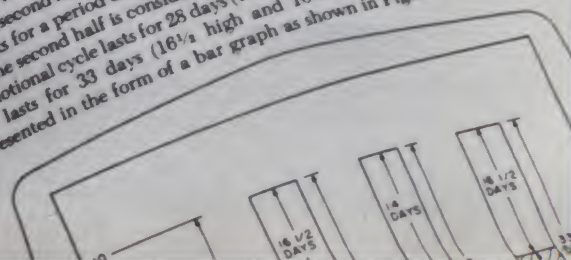


HOME APPLICATIONS

Bio-Bars—Biorhythms in Bar Graph Form

by Ronald J. Thibodeau

Here is a biorhythm program that does not need to be analyzed. If you are unhappy with the usual sine wave display currently being used for biorhythms, this bio-bars program may keep your interest up. By now, almost everyone is familiar with biorhythms and what they mean. In theory, emotional and intellectual condition. Based on the research done by doctors Swoboda and Flies, the biorhythm theory states that three cycles of 23, 28 and 33 days run concurrently from birth and continue until we die. The first half of each cycle represents an area of strength, while the second half is considered to be a low period of activity. Similarly, the emotional cycle lasts for 28 days (14 high and 14 low) and the intellectual cycle lasts for 33 days (16½ high and 16½ low). These cycles can be represented in the form of a bar graph as shown in Figure 1.



home applications

Program Listing

```
10 REM RADIO CAR CONTROL
20 REM INSERT COMMAND STRING IN LINE 100 ((256 CHAR))
30 REM 0=STRAIGHT
40 REM 1=LEFT TURN
50 REM 2=RIGHT TURN
60 REM 3=DEID
70 REM ADJUST DURATION OF COMMAND IN LINE 100
80 REM *****
90 REM *****
100 REM *****
110 REM *****
120 REM *****
130 REM *****
140 REM *****
150 REM *****
160 REM *****
170 REM *****
180 REM *****
190 REM *****
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890 REM *****
900 REM *****
910 REM *****
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930 REM *****
940 REM *****
950 REM *****
960 REM *****
970 REM *****
980 REM *****
990 REM *****
1000 REM *****
```


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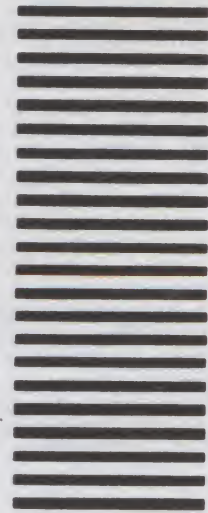
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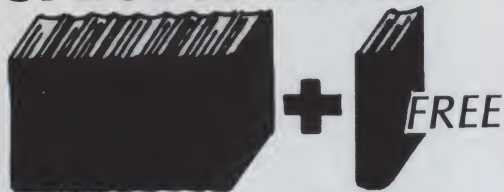
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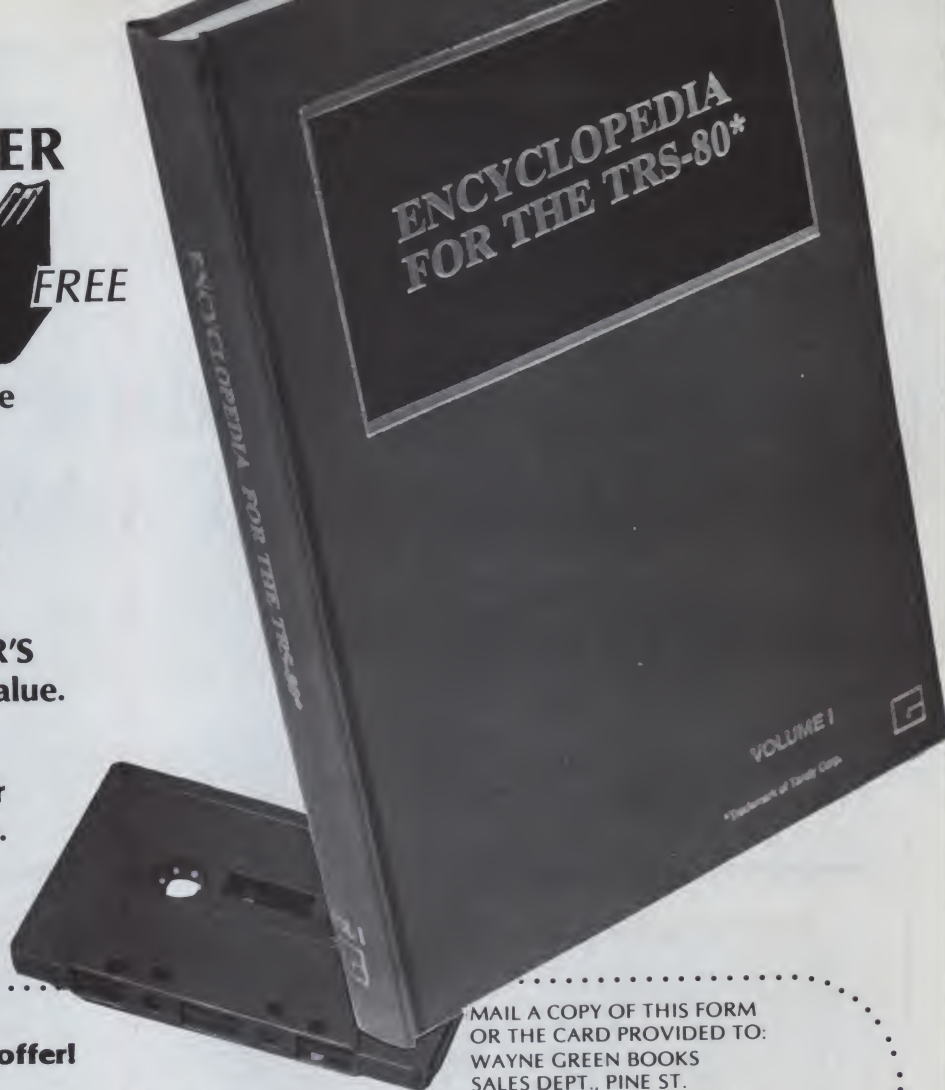
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The Revealing Truth About PET's Memory

By Charles R. Trahan

While writing a CBM 2001 program to create files on a CGRS PEDISK, I ran into a common prob-

lem. The PEDISK operating system requires you to specify the maximum number of records when a new file is

opened. I wanted the user to be able to specify this parameter and have it allocated dynamically in my program. But the DOS requires a numeric constant, not a variable.

The problem could be easily solved with Commodore's BASIC by having the user input the number of records he will require and then poking the ASCII equivalent of the input into the correct location in the OPEN statement in the program. So I needed to determine the exact memory locations (in decimal) that had to be poked.

The detective work started with the machine-language monitor. I tried to locate the line and statement that opened the new file. This can be done, but it's tricky. PET stores different ASCII codes for the same character in main memory and in screen memory. Not only must you know what to look for, but using the monitor requires hex to decimal conversion.

All this caused me to write MEMSEE. MEMSEE should be loaded before you start writing your new program if you don't have an append utility available. Line numbers start at 50000, so it won't interfere with the program line numbers.

When you want to do some poking in your program, enter the POKE

Program listing. The MEMSEE program for the CBM 2001.

```
49900 REM *** MEMSEE (MEMORY SEE) ***
49902 :
49904 REM CHUCK TRAHAN
49906 REM 4 CONGRESS COURT
49908 REM QUAKERTOWN, PA 18951
49910 REM 215-536-0264
49912 :
49914 REM APPEND TO END OF BASIC PROG
49916 REM RUN 50000.
49918 REM MEMSEE WILL DISASSEMBLE
49920 REM BASIC CODE IN MEMORY.
49922 :
49990 REM PROG INIT - USER INPUTS
50000 POKE59468,12:PRINT"HIT S TO STOP":INPUT"HI ADDRESS .":TP
50001 INPUT"LO ADDRESS .":AD:AD=AD-1:IFTP=0THENTP=99999:REM TOP DEFAULT
50002 INPUT"STOP @ LN .":LN:IFAD<1THENAD=1023:REM BOTTOM DEFAULT
50003 IFLN=0THENLN=99999:INPUT"STOP @ EOT Y":A$:C=ABS(A$="Y")
50004 INPUT"LISTING N":A$:L=ABS(A$="Y")
50006 INPUT"HARD COPY N":A$:A=ABS(A$="Y")
50007 IFATHENINPUT"DEVICE # 4":D:OPEN,D:PRINT#D,CHR$(12):CMDD
50008 PRINT:PRINT"ADDRESS","CONTENT TEXT":PRINT
50010 :
50011 REM BEGIN DISASSEMBLY - PEEK & CHECK FOR 0
50012 GOSUB62000:IFPKTHEN60000 CONTAINS OTHER THAN 0
50014 :
50015 REM END OF LINE OR END OF TEXT CHECK
50020 IFPEEK(AD+1)ORPEEK(AD+2)ORAD<1024THEN61000 CHECK FOR 3 0'S OR BELOW BASIC
50030 A$="END OF TEXT":GOSUB63300:REM 3 0'S END OF BASIC TEXT FOUND
50033 REM END OF RUN CHECKS FOLLOW
50034 REM DISPLAY NEXT 2 ADDRESSES
50035 FORI=1TO2:GOSUB62000:A$="-----":GOSUB63300:NEXT:IFCTHEN50045 STOP @ EOT
50040 IFAD<1THEN50012 NOT @ TOP
50043 :
50044 REM END OF RUN - TERMINATE ACCORDING TO USER INPUTS
50045 IFLTHENIFDTHENPRINT#D,CHR$(12):CMDD:REM NEW PAGE FOR HARD COPY LISTING
50050 IFLTHENPRINT:LIST:REM PROG LISTING @ END OF RUN
50054 IFDTHENPRINT#D,CHR$(12):CLOSED:REM CLOSE CHANNEL TO PRINTER
50055 END
50060 :
59999 REM CHECK IF QUOTES MODE OR PET TOKEN MODE
60000 IFNOTFANDPK>127ANDPK<203THEN60500:GOTO50040 NOT IN QUOTES MODE
60001 IFPK=32ORPK=160THENA$="":GOTO60019 SPACE OR SHIFTED SPACE
60002 IFPK=13ORPK=141THENA$="CARRIAGE RETURN":GOTO60019 CARRIAGE RETURN CHAR.
60003 A$=CHR$(PK):IFPK>29THEN60010 ASCII CHAR. ASSIGNED
60004 IFPK=29THENA$="CURSOR >":GOTO60019 PEEK>29 IS SPECIAL CHAR
60005 IFPK<17ORPK>20THEN60019 NOT IN 'SPECIAL' RANGE
60006 A$="CURSOR V":IFPK>17THENA$="REVERSE ON":IFPK>18THENA$="CURSOR HOME
60007 IFPK>19THENA$="DELETE":REM PET'S 'DELETE' KEY
60008 GOTO60019
60009 :
60010 IFPK=131THENA$="RUN":GOTO60019 SPECIAL CASE ASCII'S
60011 IFPK=157THENA$="CURSOR":GOTO60019 THESE 2 ARE ODD NUMBERS
60012 IFPK<145ORPK>148THEN60019 NORMAL ASCII CHAR.
60013 A$="CURSOR ^":IFPK>145THENA$="REVERSE OFF":IFPK>146THENA$="CLEAR SCREEN
60014 IFPK>147THENA$="INSERT":REM PET'S 'INSERT' KEY
60019 GOSUB63300:GOTO50040 PRINT RESULTS & CONT.
```

More

Address correspondence to Charles R. Trahan, 4 Congress Court, Quakertown, PA 18951.

command with a dummy address; i.e., POKE 0000,32 then RUN 50000. An examination of the printout (or carefully watching the CRT display) will yield the exact decimal address of interest.

There are a couple of bonuses to running MEMSEE. You will learn how the PET stores your program in memory. The end-of-line marker, link-to-next-line and line numbers become easy to see. In the PET's memory what you see is not always what you get. For instance, BASIC commands are stored as one-byte tokens. MEMSEE displays what's in memory in decimal, and what it really means to the programmer.

In addition to viewing your BASIC text, you can examine the operating system's working space, addresses 512 to 634, and you'll see your last-used strings residing there. You can look at the top of user's memory where strings are stored, or just above BASIC text where variables are stored. You may be able to recall lost data this way.

Running the Program

Slightly less than 3K bytes are required for MEMSEE. Even the longest BASIC program usually sets aside at least this amount for string storage and arrays, so MEMSEE can be appended to the end of most programs and deleted when no longer required. Admittedly, this is tedious if you have no DELETE utility. When you first load or append MEMSEE you should remove the REM statements.

When you RUN 50000, you'll see the prompt HIT S TO STOP. Runs get rather lengthy so you have the option of terminating them at any time with the S key. Don't use the stop key or files won't be closed.

The prompts HI ADDRESS, LO ADDRESS will appear next. Enter any decimal addresses you want.

The next prompt, STOP @ LN, is asking for a line number at which to end the run. Hitting RETURN will default to 99999, this being greater than any possible line number. The line number you enter does not have to actually be in your program. The run will terminate when the line number in memory is greater than the one you entered.

If you default on line number, you will be asked STOP @ EOT. This stands for end of BASIC text. Respond with Y or N. Remember, if you stop at EOT rather than a line num-

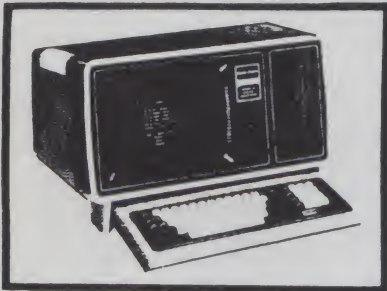
Listing continued.

```
60998 :
60999 REM CALCULATE LINK & LINE NUMBERS
61000 IFAD=1024THENAS$="-----":GOSUB63300:GOTO50012 BELOW BASIC - INVALID
61002 F=0:AS$="END OF LINE":IFAD=1024THENAS$="START BASIC TEXT
61005 GOSUB63300:GOSUB62000:AS$="LINK"+STR$(PK+256*PEEK(AD+1)):GOSUB63300
61007 GOSUB62000:AS$="-----":GOSUB63300
61010 GOSUB62000:P=PK+256*PEEK(AD+1):AS$="LINE #"+STR$(P):GOSUB63300
61015 IFP=>LNTHEN50045 CHECK FOR ENDING LINE#
61020 GOSUB62000:AS$="-----":GOSUB63300:GOTO50012
61021 :
61999 REM LOOK @ PET'S MEMORY HERE
62000 AD=AD+1:PK=PEEK(AD):GETK$:IFDTHENCMD:REM BUMP ADDRESS & PEEK IT
62010 IFK$="S"THEN50045 CHECK FOR STOP 'S' KEY
62015 IFPK=34THENF=NOTF:REM KEEP TRACK OF QUOTES
62020 RETURN
62021 :
62099 REM BASIC TOKEN LOOK-UP TABLE
63000 AS$="END":IFPK>128THENAS$="FOR":IFPK>129THENAS$="NEXT":IFPK>130THENAS$="DATA
63020 IFPK>131THENAS$="INPUT#":IFPK>132THENAS$="INPUT":IFPK>133THENAS$="DIM
63030 IFPK>134THENAS$="READ":IFPK>135THENAS$="LET":IFPK>136THENAS$="GOTO
63040 IFPK>137THENAS$="RUN":IFPK>138THENAS$="IF":IFPK>139THENAS$="RESTORE
63050 IFPK>140THENAS$="GOSUB":IFPK>141THENAS$="RETURN":IFPK>142THENAS$="REM
63060 IFPK>143THENAS$="STOP":IFPK>144THENAS$="ON":IFPK>145THENAS$="WAIT
63070 IFPK>146THENAS$="LOAD":IFPK>147THENAS$="SAVE":IFPK>148THENAS$="VERIFY
63080 IFPK>149THENAS$="DEF":IFPK>150THENAS$="POKE":IFPK>151THENAS$="PRINT#
63090 IFPK>152THENAS$="PRINT":IFPK>153THENAS$="CONT":IFPK>154THENAS$="LIST
63100 IFPK>155THENAS$="CLR":IFPK>156THENAS$="CMD":IFPK>157THENAS$="SYS
63110 IFPK>158THENAS$="OPEN":IFPK>159THENAS$="CLOSE":IFPK>160THENAS$="GET
63120 IFPK>161THENAS$="NEW":IFPK>162THENAS$="TAB(":IFPK>163THENAS$="TO
63125 IFPK>164THENAS$="FN
63130 IFPK>165THENAS$="SPC(":IFPK>166THENAS$="THEN":IFPK>167THENAS$="NOT
63140 IFPK>168THENAS$="STEP":IFPK>169THENAS$="+":IFPK>170THENAS$="-
63145 IFPK>171THENAS$="
63150 IFPK>172THENAS$="/":IFPK>173THENAS$="^":IFPK>174THENAS$="AND
63155 IFPK>175THENAS$="OR
63160 IFPK>176THENAS$=">":IFPK>177THENAS$="=":IFPK>178THENAS$="<
63165 IFPK>179THENAS$="SGN
63170 IFPK>180THENAS$="INT":IFPK>181THENAS$="ABS":IFPK>182THENAS$="USR
63175 IFPK>183THENAS$="FRE
63180 IFPK>184THENAS$="POS":IFPK>185THENAS$="SOR":IFPK>186THENAS$="RND
63185 IFPK>187THENAS$="LOG
63190 IFPK>188THENAS$="EXP":IFPK>189THENAS$="COS":IFPK>190THENAS$="SIN
63195 IFPK>191THENAS$="TAN
63200 IFPK>192THENAS$="ATN":IFPK>193THENAS$="PEEK":IFPK>194THENAS$="LEN
63210 IFPK>195THENAS$="STR$":IFPK>196THENAS$="VAL":IFPK>197THENAS$="ASC
63220 IFPK>198THENAS$="CHR$":IFPK>199THENAS$="LEFT$":IFPK>200THENAS$="RIGHT$
63230 IFPK>201THENAS$="MID$":IFPK>202THENAS$="-----":IFPK=255THENAS$="CHR$(222)
63231 :
63299 REM DISPLAY RESULTS HERE
63300 PRINTAD,PK:SPC(10-LEN(STR$(PK)))AS$:IFD=0THENPRINT
63310 RETURN
```

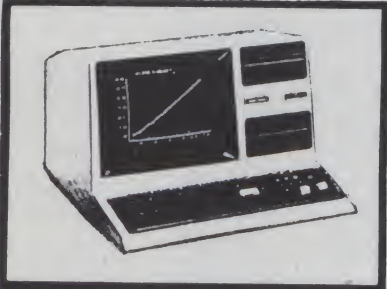
1015	0	----
1016	0	----
1017	0	----
1018	247	-
1019	231	I
1020	4	
1021	207	┌
1022	0	----
1023	142	RETURN
1024	0	START BASIC TEXT
1025	55	LINK 1079
1026	4	----
1027	80	LINE # 50000
3772	0	END OF LINE
3773	211	LINK 3795
3774	14	----
3775	68	LINE # 63300
3776	247	----
3777	153	PRINT
3778	65	A
3779	68	D
3780	44	,
3781	80	P
3782	75	K
3783	44	,
3784	65	A
3785	36	\$
3786	59	:
3787	58	:
3788	139	IF
3789	68	D
3790	178	=
3791	48	0
3792	167	THEN
3793	153	PRINT
3794	0	END OF LINE
3795	217	LINK 3801
3796	14	----
3797	78	LINE # 63310
3798	247	----
3799	142	RETURN
3800	0	END OF TEXT
3801	0	----
3802	0	----

Sample run. Starts below BASIC text, terminates at line 50000 and is rerun from address 3772 to the end of text.

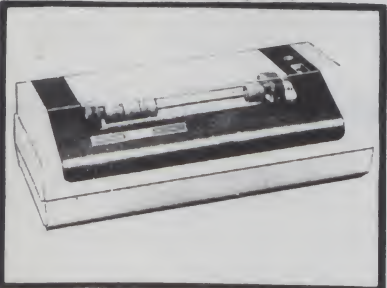
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ber, MEMSEE will be included in the disassembly.

Answer Y or N to LISTING. If you answer yes, a program listing will be given at the end of run. When the listing is complete, type GOTO 50054 and RETURN to properly close all files.

If you answered no, you will be asked if you want hard copy. A yes answer to either question will cause the prompt DEVICE # to be displayed. This permits hard copy to any printer.

After device #, or a no answer to the listing and hard copy prompts, the run will start. If your display is on the screen, it will scroll at a fairly readable rate. The S key will end the listing immediately, or use the stop key and CONT command to freeze the display. The scroll can be slowed down with the OFF/RVS key in the usual manner.

Program Description

A poke to graphics mode in line 50000 is required for a correct print-out. Parameters are then entered in lines 50000 to 50008.

Line 50010 determines if a 0 was

found marking the end of a line. Line 50020 then checks for two more 0's marking the end of BASIC text.

If no 0's were found, the program branches to line 60000. The variable F indicates quotes mode and determines if peeks greater than 127 will be tokens (numeric values representing BASIC commands) or special PET characters such as cursor control. The proper token is looked up in lines 63000 to 63230 or the special character in lines 60001 to 60014. Values failing the special character check are assigned as ASCII in line 60003.

If an end-of-line 0 was found, but not followed by two more 0's, a branch is taken (line 50020) to line 61000. This is where the link and line numbers are calculated and displayed.

One special case is when the address is below 1024, start of BASIC. This is handled in lines 50020 to 61000. Addresses above the BASIC storage area will be seen as BASIC and print mostly nonsense, but string and variable storage should still be apparent.

Type in the program and try a run. You will see it disassemble itself. ■

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Backslashes to Colons

By John A. Bryant

North Star BASIC makes unusual use of such delimiters as the backslash and the comma. While many BASICs use the comma and the semicolon, North Star uses only the comma and gives it the meaning other BASICs attach to the semicolon. Also, in North Star the backslash is used instead of the colon to separate statements on the same line.

To add to all the confusion, my printer doesn't recognize a backslash. So before I send a listing to someone, I have to put in colons or backslashes by hand and change all the commas to semicolons.

It occurred to me that someone with a computer shouldn't be doing all that tedious work, so I dashed off an assembly-language program to quickly make the changes. The program was suggested by Rinaldo Prisco's space remover program in the January 1981 *Microcomputing* (p. 40).

My program, like Prisco's, operates on the BASIC program while it is in memory, and thus is lightning-fast. It should be assembled to load at some free area that will not be occupied by the BASIC program—either high memory or below DOS. When it finishes its work, it returns you to BASIC, and the modified program can be either directed to the screen or printer with the LIST command, or saved to disk for later printing.

Address correspondence to John A. Bryant, 6648 N. Canandaigua Road, Holcomb, NY 14469.

How It Works

The program examines each byte of the BASIC program in memory and checks to see if it is a backslash (5C in hexadecimal) or a comma (2C). If the byte does represent one of those characters, it is replaced by the appropriate character, by means of a move immediate (MVI) instruction.

Remarks and matter within quotes or parentheses branch to the REM, QUOTE and PAREN routines, so that commas there are not changed. However, since my printer won't print a backslash, I designed the program to convert backslashes to colons no matter where they are found.

The SKIP routine is used to skip over line-number references, since they may contain the hexadecimal values of a backslash or a comma. North Star BASIC uses a 1 to mark the end of the program, so line 180 checks to see if the end of the program in memory has been reached, in which case a jump is made to an entry point for BASIC (line 170).

Entering the Program

The program is short; anyone with an assembler can enter it quickly using assembly-language mnemonics, and can then assemble it at any location. Note that the hex value at line 130 represents the last byte of BASIC, and the value at line 170 is a BASIC entry point. The values given are for release 5.0; if you are using a different version, you'll have to enter

the appropriate values.

Even if you don't have an assembler and don't know assembly language from Latin, you can still enter and use this program.

The right-hand two-thirds of Listing 1 shows the assembly-language coding with remarks; the left columns represent the assembled version, assembled at 0000H. Listing 2 shows just the assembled version, assembled not at 0000H, but at the top of memory in a 32K machine with memory from 2000H to 9FFFH. Note that the four hexadecimal digits at the far left are the memory locations where the values shown at the immediate right are stored. When there is one two-digit value to the right, the memory locations increment by one; when there are two, the next location is incremented by two, and so on.

With that background, here's how to enter and save this program without an assembler:

- Decide whether you want to locate the program at 0000H or at 9F8BH.

- Load one of North Star's monitors at a location that will not overlap DOS or the area where the program is to be placed.

- Use the DS (display storage) feature of the monitor. If you're assembling at 0000H, enter DS 0, followed by a carriage return (otherwise, enter DS 9F8B, then the carriage return). The monitor will display the value at that location, followed by an

equals sign.

●You then enter 21, press the space bar (not the carriage return), 9D, space bar, 5F, space bar, 23, space bar, and so on until you get to the end of the assembly listing, at which time you should press the carriage return. (Actually, at lines 130 and 170 you should enter the appropriate values for your version of North Star BASIC, as explained above. Note that when you're using the monitor they are entered backwards, that is,

5F9D would be entered 9D 5F.)

●Return to DOS by entering OS (Operating System), followed by a carriage return.

●Now create a file on a disk to hold the program by using the DOS CR and TY commands. For example, enter CR REPLACE 2 (carriage return), then TY REPLACE 1 0 (carriage return) or TY REPLACE 1 9F8B (carriage return), depending on where you located it.

●Finally, type SF REPLACE 0 (carriage return) or SF REPLACE 9F8B (carriage return), as the case may be.

riage return) or SF REPLACE 9F8B (carriage return), as the case may be.

Using REPLACE

Any time you wish to modify a BASIC program for printing, load BASIC, load the program to be modified, use BYE to drop into the DOS, then type GO REPLACE (carriage return). Quick as a wink, the program will be modified and you will return to BASIC, where you can either list the modified program to the screen or printer or save it to disk. To modify additional programs once REPLACE has been loaded, merely load the program to be modified, press control-C, then enter JP 0 or JP 9F8B. Again, the program will be modified and you'll be back in BASIC in a flash.

This program is so fast that if you haven't been returned to BASIC and the READY prompt hasn't been printed within about three seconds after running REPLACE, something is wrong. You should reboot (press reset) and check to make sure REPLACE has been entered correctly and the other steps have been followed correctly.

One last point should be made with

```

0000          0010 ;          REPLACE
0000          0020 ;
0000          0030 ; FOR NORTH STAR BASIC PROGRAMS
0000          0040 ;
0000          0050 ;
0000          0060 ;CHANGES BACKSLASHES TO COLONS,
0000          0070 ;CHANGES DELIMITER COMMAS TO SEMICOLONS.
0000          0080 ;
0000          0090 ;HEX VALUE AT LINE 130 IS LAST BYTE OF BASIC.
0000          0100 ;HEX VALUE AT LINE 170 IS ENTRY POINT OF BASIC.
0000          0110 ;
0000          0120 ;
0000 21 9D 5F 0130 LXI H,5F9DH ;LAST BYTE OF BASIC
0003 23 0140 NEW INX H ;SKIP BYTE FOR # CHR$ /LINE
0004 7E 0150 MOV A,M ;PUT VALUE AT H IN A
0005 FE 01 0160 CPI 1 ;END OF PROGRAM?
0007 CA 04 2D 0170 JZ 2D04H ;YES-JUMP TO BASIC
000A 23 0180 SKIP INX H ;SKIP OVER LINE NO.
000B 23 0190 INX H
000C 23 0200 CHECK INX H ;GO TO NEXT BYTE
000D 7E 0210 MOV A,M
000E FE 9A 0220 CPI 9AH ;REFERENCED LINE NO.?
0010 CA 0A 00 0230 Z SKIP
0013 FE 0D 0240 CPI 0DH ;END OF LINE?
0015 CA 03 00 0250 JZ NEW
0018 FE 8F 0260 CPI 8FH ;REMARK?
001A CA 3B 00 0270 JZ REM
001D FE 22 0280 CPI 22H ;QUOTE?
001F CA 4C 00 0290 JZ QUOTE
0022 FE E0 0300 CPI 0E0H ;LEFT PARENTHESIS?
0024 CA 62 00 0310 JZ PAREN
0027 FE 2C 0320 CPI 2CH ;COMMA?
0029 C2 31 00 0330 JNZ NEXT
002C 36 3B 0340 MVI M,3BH ;SUBSTITUTE A SEMICOLON
002E C3 0C 00 0350 JMP CHECK
0031 FE 5C 0360 NEXT CPI 5CH ;BACKSLASH?
0033 C2 0C 00 0370 JNZ CHECK
0036 36 3A 0380 MVI M,3AH ;SUBSTITUTE A COLON
0038 C3 0C 00 0390 JMP CHECK
003B 23 0400 REM INX H ;ROUTINE FOR REMARKS
003C 7E 0410 MOV A,M
003D FE 0D 0420 CPI 0DH ;END OF LINE?
003F CA 03 00 0430 JZ NEW
0042 FE 5C 0440 CPI 5CH ;BACKSLASH?
0044 C2 3B 00 0450 JNZ REM
0047 36 3A 0460 MVI M,3AH ;SUBSTITUTE A COLON
0049 C3 0C 00 0470 JMP CHECK
004C 23 0480 QUOTE INX H ;ROUTINE FOR CHARS.
004D 7E 0490 MOV A,M ;WITHIN QUOTES
004E FE 22 0500 CPI 22H ;QUOTE CLOSED?
0050 CA 0C 00 0510 JZ CHECK
0053 FE 0D 0520 CPI 0DH ;END OF LINE?
0055 CA 03 00 0530 JZ NEW
0058 FE 5C 0540 CPI 5CH ;BACKSLASH?
005A C2 4C 00 0550 JNZ QUOTE
005D 36 3A 0560 MVI M,3AH ;SUBSTITUTE A COLON
005F C3 4C 00 0570 JMP QUOTE
0062 23 0580 PAREN INX H ;ROUTINE FOR CHARS.
0063 7E 0590 MOV A,M ;WITHIN PARENTHESES
0064 FE 29 0600 CPI 29H ;PARENTHESES CLOSED?
0066 CA 0C 00 0610 JZ CHECK
0069 FE 0D 0620 CPI 0DH ;END OF LINE?
006B CA 03 00 0630 JZ NEW
006E FE 5C 0640 CPI 5CH ;BACKSLASH?
0070 C2 62 00 0650 JNZ PAREN
0073 36 3A 0660 MVI M,3AH ;SUBSTITUTE A COLON
0075 0670 END ;END

```

SYMBOL TABLE

```

CHECK 000C NEW 0003 NEXT 0031 PAREN 0062 QUOTE 004C
REM 003B SKIP 000A

```

Listing 1. Replace program in assembly language for North Star BASIC.

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reference to using REPLACE. If you edit any line of the BASIC program after running REPLACE on it, any semicolons or colons in that line will be changed back to commas or backslashes by routines within BASIC. While that can be prevented by a couple of FILLs, it is easier to just run REPLACE again.■

9F8B 21 9D 5F
9F8E 23
9F8F 7E
9F90 FE 01
9F92 CA 04 2D
9F95 23
9F96 23
9F97 23
9F98 7E
9F99 FE 9A
9F9B CA 95 9F
9F9E FE 0D
9FA0 CA 8E 9F
9FA3 FE 8F
9FA5 CA C6 9F
9FA8 FE 22
9FAA CA D7 9F
9FAD FE E0
9FAF CA ED 9F
9FB2 FE 2C
9FB4 C2 BC 9F
9FB7 36 3B
9FB9 C3 97 9F
9FBC FE 5C
9FBE C2 97 9F
9FC1 36 3A
9FC3 C3 97 9F
9FC6 23
9FC7 7E
9FC8 FE 0D
9FCA CA 8E 9F
9FCD FE 5C
9FCF C2 C6 9F
9FD2 36 3A
9FD4 C3 97 9F
9FD7 23
9FD8 7E
9FD9 FE 22
9FDB CA 97 9F
9FDE FE 0D
9FE0 CA 8E 9F
9FE3 FE 5C
9FE5 C2 D7 9F
9FE8 36 3A
9FEA C3 D7 9F
9FED 23
9FEE 7E
9FEF FE 29
9FF1 CA 97 9F
9FF4 FE 0D
9FF6 CA 8E 9F
9FF9 FE 5C
9FFB C2 ED 9F
9FFE 36 3A
A000

SYMBOL TABLE

CHECK 9F97 NEW 9F8E
REM 9FC6 SKIP 9F95
NEXT 9FBC PAREN 9FED
QUOTE 9FD7

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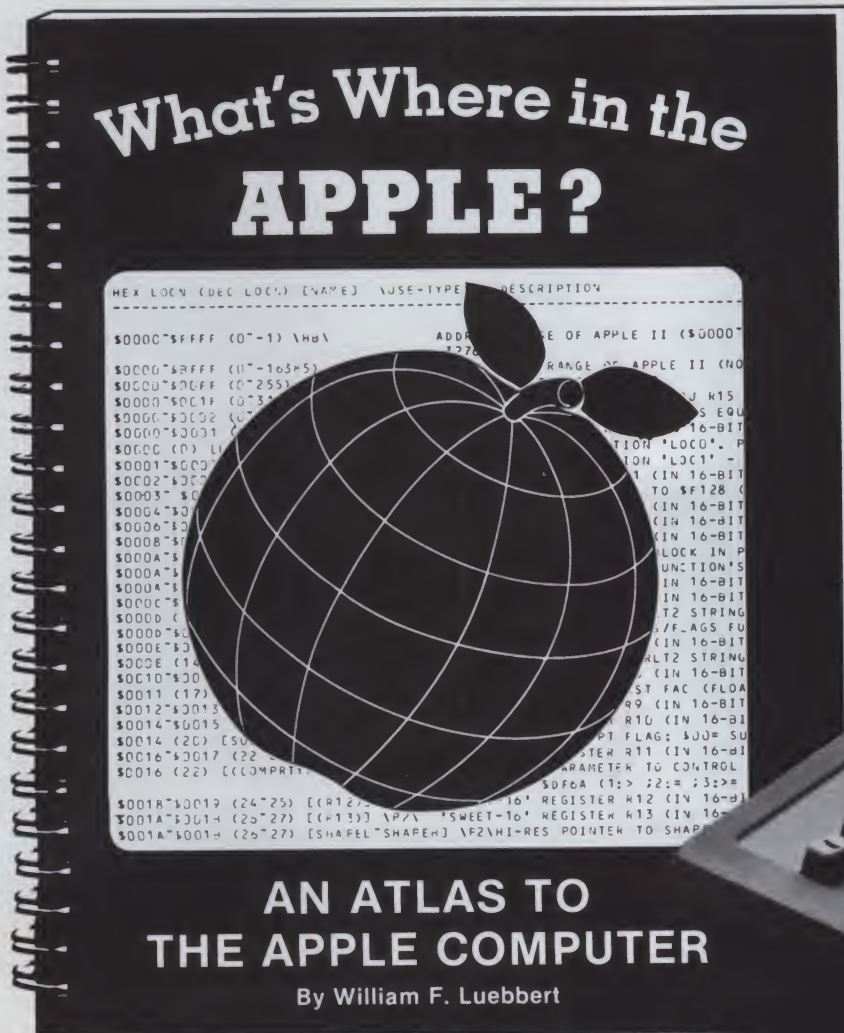
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Which Way Is Best?

By Louis C. Graue

Everyone wants to do things efficiently. These computer techniques present optimization solutions to people who have little time to develop expertise in mathematical programming, decision-makers working on any quantitative project, and people who never liked mathematics because it was too difficult.

You don't need to know any math, except how to read equations and inequalities involving variables and arithmetic operations. You need to know enough BASIC to understand FOR...NEXT loops. The necessary programs are very short.

If a problem has less than a million feasible solutions, the computer's speed lets you test every one of them and pick the best. When billions of solutions are feasible, you take random samples of millions of them and find the optimum of that sample. The first two examples below illustrate how to test all possible solutions. The last example shows how to use the Monte Carlo technique.

Maximum Profit

Suppose your company manufactures products A and B at a profit of \$50 and \$75, respectively. You know that department 1 takes ten hours to

make product A and six hours to make product B. Department 2 requires five hours to make product A and 14 hours to make product B. Department 1 has no more than 200 man-hours available per day. Department 2 has no more than 300 man-hours per day available. You wish to find the number of units of A and B that should be made to maximize the profit.

Let x be the number of units of product A and y the number of units of product B. The relevant information can be summarized as follows: Maximize $P = 50x + 75y$ subject to $10x + 6y \leq 200$ and $5x + 14y \leq 300$. Notice that the inequalities restrict x to be no larger than 20 and y to be no larger than 21.

Program listing 1 examines all $20 \times 21 = 420$ feasible solutions in a few seconds and prints the best solution. Line 20 declares the variables to be integers. In line 30 we initialize the variable PM to be less than any possible maximum. Zero is sufficient here since all of the variables are non-negative integers.

The FOR...NEXT loops consider the following ordered pairs: (0,0), (0,1), (0,2), ..., (0,21), (2,0), (2,1), (2,2), ..., (2,21), ..., (20,21). The first

of these pairs to satisfy the constraints of lines 50 and 60 will get to line 70 and evaluate the P function. Then line 80 compares this P function value with the current value of PM, which is 0. Therefore, P will be larger and is stored in PM (along with the x, y values that produced P), erasing 0. This process continues, and each time a P value is greater than the currently stored PM value (the maximum so far), the program jumps to the storage area and stores the new maximum. Finally, at the end of the program, the current stored maximum is the true maximum, because all possible solutions have been considered.

Minimum Delivery Cost

You have two sources for a product and three locations (A, B and C) where you need supplies. A needs ten units, B needs eight units and C needs 30 units. Source 1 can furnish 30 units and source 2 has 18 units. The cost of delivering one unit from source i to location j is shown in Table 1.

How should the 48 units needed be ordered to minimize the cost of delivery?

Let A_1 be the number of units from source 1 to location A, A_2 the number of units from source 2 to location A and so on. The problem can then be summarized as follows: Minimize $C = 620A_1 + 66B_1 + 72C_1 + 58A_2 + 132B_2 + 104C_2$, subject to $A_1 + B_1 + C_1 = 30$, $A_2 + B_2 + C_2 = 18$, $A_1 + A_2 = 10$, $B_1 + B_2 = 8$ and $C_1 + C_2 = 30$.

```
10 ' PROGRAM 1
20 DEFINT X,Y,P
30 PM=0
40 FOR X=0 TO 20:FOR Y=0 TO 21
50 IF 10*X+6*Y>200 GOTO 90
60 IF 5*X+14*Y>300 GOTO 90
70 P=50*X+75*Y
80 IF P>PM THEN PM=P:XM=X:YM=Y
90 NEXT Y:NEXT X
100 PRINT"THE SOLUTION IS:"
110 PRINT"    X=";XM;"    Y=";YM;"    AND MAXIMUM P=";PM
120 END
```

Program listing 1. Programs written for the TRS-80.

Address correspondence to Louis C. Graue, 624 Campbell Hill Road, Bowling Green, OH 43402.

From the constraints you can see that A1 must be less than or equal to 10 ($A1 + A2 = 10$), and B1 must be less than or equal to 8 ($B1 + B2 = 8$). Also, C1 must be equal to $30 - A1 - B1$. A2 must be less than or equal to 10 ($A1 + A2 = 10$), and B2 must be less than or equal to 8 ($B1 + B2 = 8$). Also, C2 must equal $18 - A2 - B2$ ($A2 + B2 + C2 = 18$).

Program listing 2 examines all 9801 ($11 \times 9 \times 11 \times 9$) feasible solutions and takes just over four minutes to complete the problem. By placing the print statement within the loops, each currently stored minimum will be printed (so you will have something to watch while waiting for the solution). The last one printed will be the best solution.

Eight units should be ordered from source 1 for location B; 22 units from source 1 for location C; ten units from source 2 for location A, and eight units from source 2 for location C to minimize the delivery costs, which will be \$35.24.

Monte Carlo Programming

If a problem has ten variables and each has only ten values, then you will have 10^{10} cases to examine. At the rate of one set of values per millisecond, 10^7 seconds is required to examine them. This is something more than 10^5 hours, or about ten years. To obtain a solution in a reasonable amount of time, take a random sample of a million feasible solutions and find the optimum of that sample using the same techniques explained above.

How good is the answer obtained by this method? Statistical procedures have been used to show that in any practical problem the answer is nearly optimum. However, even if this were not true, you would still have the best course of action out of millions of decisions. This method may not have been practical in the days when we had to pay dearly for computer time, but many microcomputers are turned off for the majority of the time. If this is the case, they could be working on the Monte Carlo programming problem for part of that time.

To illustrate the Monte Carlo technique, you seek to maximize

$$P = X_1^2 + X_2^2 + 3X_3^2 + 4X_4^2 + 2X_5^2 - 8X_1 - 2X_2 - 3X_3 - X_4 - 2X_5$$

subject to

$$X_1 < 100, X_2 < 100, X_3 < 100,$$

$$X_4 < 100, X_5 < 100$$

$$X_1 + X_2 + X_3 + X_4 + X_5 < 401$$

$$X_1 + 2X_2 + 2X_3 + X_4 + 6X_5 < 801$$

$$2X_1 + X_2 + 6X_3 < 201$$

$$X_3 + X_4 + 5X_5 < 201$$

with all variables non-negative integers.

There are 10 billion sets of values to be checked. Look at a random sample of 1 million points and take the one that gives a maximum P. Examine Program listing 3 and notice that we have not set up a FOR...NEXT loop for each variable as we did in the previous examples. We have set up one outside FOR...NEXT loop on J running from 1 to 1,000,000. Each time J assumes a new value, line 40 assigns each variable X_1, X_2, X_3, X_4 and X_5 a random value between 0 and 99. This set of values is checked as before, and the current best value is stored in PM. We get a printout of the form (X_1, X_2, X_3, X_4, X_5) PM each time a new maximum is found. This shows the set of values giving the current maximum. The last value printed is the maximum P for the 1 million

points checked.

I've run this program three times and the best value obtained so far was 50420 at (50, 97, 0, 99, 1).

Conclusion

By following the examples, you should be able to write a program to solve optimization problems. You only need to substitute your function and constraints in place of the ones in the examples. The variables must have integer values. The variable which stores the extreme value must be initialized larger than any possible value of the function if you're seeking the minimum, or smaller than any possible value if you are finding a maximum.

If you wish to learn more about these techniques, I suggest the book *Computer Optimization Techniques* by William Conley (Petrocelli Books, Inc.). It's well written, elementary and contains a large number of examples. ■

Delivery Cost

From Source	To Location A	To Location B	To Location C
1	\$6.20	\$.66	\$.72
2	\$.58	\$1.32	\$1.04

Table 1.

```
10 ' PROGRAM 2
15 DEFINT A,B,C
20 CM=32700
30 FOR A1=0 TO 10:FOR B1=0 TO 8:FOR A2=0 TO 10:FOR B2=0 TO 8
40 C1=30-A1-B1:C2=18-A2-B2
50 IF A1+A2<>10 GOTO 110
60 IF B1+B2<>8 GOTO 110
70 IF C1+C2<>30 GOTO 110
80 C=120*A1+66*B1+72*C1+58*A2+132*B2+104*C2
90 IF C<=CM THEN CM=C ELSE 110
100 PRINT A1;B1;C1;A2;B2;C2; CM
110 NEXT B2:NEXT A2:NEXT B1:NEXT A1
120 END
```

Program listing 2.

```
10 ' PROGRAM 3
20 DIM X(5)
30 PM=0
35 FOR J=1 TO 1000000
40 FOR I=1 TO 5:X(I)=RND(100)-1:NEXT I
50 IF X(1)+X(2)+X(3)+X(4)+X(5)>400 GOTO 200
60 IF X(1)+2*X(2)+2*X(3)+X(4)+6*X(5)>800 GOTO 200
70 IF 2*X(1)+X(2)+6*X(3)>200 GOTO 200
80 IF X(3)+X(4)+5*X(5)>200 GOTO 200
90 P=X(1)*X(1)+X(2)*X(2)+3*X(3)*X(3)+4*X(4)*X(4)+2*X(5)*X(5)-8*X(1)-2*X(2)-3*X(3)-X(4)-2*X(5)
100 IF P>=PM THEN PM=P ELSE 200
110 PRINT "(X(1);X(2);X(3);X(4);X(5));PM"
200 NEXT J
210 END
```

Program listing 3.

Treat Your File Directory As Data

By Stephen Lewis

I run North Star BASIC on my Altair, and use it to keep track of stock prices, interest rates and other data. Several of the programs I've written require me to input the name of a disk file for the program to operate on. But two problems may arise.

First, a typing or file name error, or a failure to remember which drive holds the data disk ends program execution. Second, I may not know the complete file name, only the first one or two characters.

Also, I may wish to get a partial printout of the file directory (e.g., those with file names starting with NV), not the complete directory.

Thus, I need to be able to treat the file directory as data. I could use the

ERRSET statement to catch the FILE ERROR IN LINE XXXX message without ending program execution, but this still leaves me guessing what the correct file name is. It also does not help me get my partial printout. I could keep a separate data file on the disk, duplicating the file directory, and update it every time I create or destroy a file. I don't like that method because most of my data files are created by programs and are not in the command mode.

This program, called Quest, solves

these problems. I use the statement READ#F,&N as part of the program. F is the number of a file with the name of the disk (the identifier for the four sectors, eight in quad density systems) starting at track 0, sector 0, on the disk. For the diskette supplied by North Star, this is MDQ-R5.1. N is a variable name. The & in front of the N signifies that the file is to be read one byte at a time. This method is necessary because the disk directory is not in the form of BASIC strings or numbers. ■

```
WORDPRO DISK ADDR 73
IT IS 48 BLOCKS LONG
SINGLE DENSITY
ITS FILE TYPE IS 7
TYPE DEPENDENT INFORMATION 24 45 32
```

```
SEPT DISK ADDR 145
IT IS 6 BLOCKS LONG
ITS FILE TYPE IS 3
TYPE DEPENDENT INFORMATION 8 32 32
```

```
BASIC DISK ADDR 10
IT IS 52 BLOCKS LONG
ITS FILE TYPE IS 1
GO ADDRESS IS 11520
TYPE DEPENDENT INFORMATION 0 45 32
```

Sample output.

```
10 REM * * * PROGRAM NAME IS QUEST * * *
15 INPUT "DESIRED OUTPUT DEVICE",P
20 INPUT "DISK NAME ",A$
30 INPUT "NAME OF FILE TO LOOK FOR ",A1$
40 IF LEN(A1$)=8 THEN 80
50 IF LEN(A1$)>8 THEN 30 \ REM * * * FILE NAMES ARE 8 CHARACTERS MAXIMUM
60 A1$ = A1$ + " " \ REM ADD SPACES TO MAKE UP 8 CHARACTERS
70 IF LEN(A1$)<8 THEN 60
80 OPEN #1#0,A$ \ REM THIS OPENS DISK DIRECTORY FILE
90 FOR J = 1 TO 128 \ REM * * * 128 FOR A DOUBLE DENSITY DISK
100 FOR I = 1 TO 8
110 READ#1,&X(I) \ REM THIS READS THE FILENAME FROM THE DIRECTORY
120 NEXT I
130 FOR I=1 TO 8 \ READ#1,&Y(I) \ NEXT I
140 A2$="" \ REM * * * THE NULL STRING
150 FOR I = 1 TO 8
160 A2$=A2$+ CHR$(X(I)) \ REM * * * THIS REASSEMBLES FILENAME
170 NEXT I
180 IF A2$ = " " THEN 280 \ REM 8 SPACES BETWEEN THE QUOTE MARKS
190 IF A1$ = A2$ THEN 210
200 GOTO 280
210 PRINT#P,A2$," DISK ADDRESS ",I#P,(Y(1)+256*Y(2))
PRESS RETURN TO CONTINUE
220 PRINT#P,"IT IS ",(2*(256*Y(4)+Y(3))), "BLOCKS LONG "
230 IF Y(5)<128 THEN I#P,"SINGLE DENSITY " ELSE Y(5)=Y(5)-128
240 PRINT#P,"ITS FILE TYPE IS ",Y(5)
250 IF Y(5)=1 THEN I#P,"GO ADDRESS IS ",(256*Y(7)+Y(6))
260 I#P,"TYPE DEPENDENT INFORMATION IS ",Y(6),Y(7),Y(8)
270 GOTO 300
280 NEXT J
290 PRINT#P,"FILE NOT ON THIS DISK "
300 CLOSE#1 \ GOTO 10
READY
```

Quest program listing.

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EXAMPLES FROM MTU-BASIC

ENTER "TRANSFER3"

Reads in an ASCII text file as program statements.

SYSTEM "ASSIGN 1 BASICIN"

Redirects input from keyboard to disk file named BASICIN.

LEGEND 1, "First," "Second"

Relegends function keys 1 and 2 to read "First" and "Second".

LTPEN F, X, Y

Sets F=1 and X, Y to coordinates when lightpen picks a point.

GRIN NW\$, X, Y

Displays crosshair and inputs X, Y location of its final position; NW\$ contains the exit key.

DRAW .0645, 3*Y

Draw a vector from current location of graphic cursor to specified coordinates.

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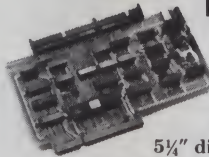
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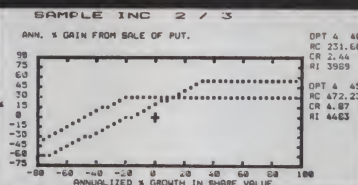
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Little Bits

Bag It

By Kenneth Reid

Many computer hobbyists and professionals have been made painfully aware of the disastrous effects of spilled liquids—coffee and soft drinks, in particular—on computer keyboards. Once the gunk gets in around the keys it is nearly impossible to remove, and the sticky keys are a continual aggravation.

The best remedy is prevention. A thin sheet of transparent plastic, secured over the keyboard, will ward off spills without affecting keyboard operation. If your keyboard is separated from your video screen, as mine is, you can simply place the entire keyboard in a large clear plastic bag. If you have an all-in-one system, a sheet of Saran Wrap or similar clear plastic material will provide nearly the same level of protection if well secured with masking tape.

So before you eat, drink or make merry at your keyboard, bag it! The temper you save will be your own. ■

Kenneth Reid, 1935 Trevilian Way, Louisville, KY 40205.

Hex Table

By F. LaPointe

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

Hex addition/subtraction table.

Remember those math tables from Rgrade school? Here's a little hex table to keep handy when you're writing that relative addressing instruction in assembly language.

F. LaPointe, 33 Windsor Court, Lansdale, PA 19446.

Putting PET To the Test

By Garold R. Stone

Here is an adaptation for the PET computer of Fred Monsour's rigorous machine-language RAM test program ("Cook's Memory Test for the 6502," *Microcomputing*, June 1980, p. 178). It can be loaded and run on new ROM (3.0) and old ROM (2.0) PETs, with or without the machine-language monitor.

The Test

The program (Listing 1) repeatedly tests a specified range of RAM, printing an asterisk (*) as it completes each pass. If a bad byte is found, an error code (A,B,C; or D) will be printed, followed by the faulty address in hexadecimal. It takes about three seconds to test each eight kilobytes of RAM.

According to Monsour's article, error code "A indicates a byte that can't have all 0's stored in it. Error B usually is due to shorted or open address lines, while error C is due to shorted or open data lines. Error D signifies a byte that can't store all 1's."

For example, if an error C is found, the location of the bad bit (1-8) is printed first, followed by the error

code and the hexadecimal address 4C1000.

From KIM to PET

Monsour's KIM program is self-contained, except for the use of one KIM ROM routine, OUTCHR, to output the results of the test. I substituted a PET ROM routine, WRT, which prints the contents of the 6502 accumulator as a character on the screen. It also updates the cursor position to be

ready for the next character. No 6502 registers are changed by WRT.

Relocating the program to PET's second cassette buffer area was straightforward. None of the branch instructions had to be changed—just the jump and jump subroutine instructions. I changed the variables to locations which would not conflict with the operation of the BASIC interpreter in either the old or new ROM. I put the test in the second cassette buffer so that all of the PET's absolute RAM (0400 hex up) could be tested in one pass.

Unlike the KIM, the PET has no key that will trigger a hardware interrupt to stop a machine-language program, so I added a software interrupt routine. Where Monsour's program calls subroutine INC to increment the pointer, POINTL,H, to the next byte to be tested, I substituted a call to my subroutine, STOP (03ED hex), which tests for any depressed key (except shift). If no key is down, the PET ROM routine GET returns with the zero status flag set.

The branch if equal (BEQ) test is satisfied and the program branches to the instruction JUMP INC. INC increments the test pointer, POINTL,H, and returns to the address just below where STOP was called. If a key is down, the branch test fails and the software break instruction (BRK) is executed.

BRK loads the 6502 program counter with the address specified in the

Set BRK interrupt vector for BASIC:

Old ROM	New ROM
POKE 539,137	POKE 146,137 (low byte)
POKE 540,195	POKE 147,195 (high byte)

Set test range from BASIC:

POKE 60, SL	(STARTL)
POKE 61, SH	(STARTH)
POKE 62, EL	(ENDL)
POKE 63, EH	(ENDH)

(See Table 2 for decimal values.)

Run test: SYS 826

Table 1. Running under BASIC.

Memory size in hex	SL	SH	EL	EH
8K (0400-2000)	0	4	0	32
16K (0400-4000)	0	4	0	64
24K (0400-6000)	0	4	0	96
32K (0400-8000)	0	4	0	128
32K plus video (0400-8400)	0	4	0	132
Video only (8000-8400)	0	128	0	132

Table 2. Test range values in decimal.

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contents of the break interrupt vector. In new ROM PETs the break interrupt vector (0092,0093 hex) is set at power on (or reset) to contain the address of the warm start entry point for the machine-language monitor in ROM (FD17 hex). Commodore calls this monitor TIM for terminal interface monitor. In old ROM PETs the break interrupt vector is set to TIM's warm start address when TIM is loaded and run from tape. Users of old ROM may wish to use the program in Listing 2 to load the test, but they will

have to set the break interrupt vector to the warm start point for BASIC, so that the test will return to BASIC when a key is pressed. Table 1 shows how to set up and run the test from BASIC, for old and new ROMs.

Running under TIM

Enter TIM and set the range of RAM to be tested in the variables START and END. Put the low-order byte of the starting address (in hex) into STARTL and the high-order byte in STARTH. The variable END

should be set to one byte higher than the last byte to be tested. ENDL is the low-order byte and ENDH is the high-order byte. Execute the program from the monitor with G 033A. Pressing any key during the test will cause a break back to the machine-language monitor.

General Considerations

Remember that the first kilobyte of RAM (0000-03FF hex) cannot be tested because it holds the pointers for the PET operating system. Testing this area would cause the PET to go out of control. To test the two RAM

```

033A 20 97 03 JSR $0397
033D A9 00 LDA #$00
033F A8 TAY
0340 91 54 STA ($54),Y
0342 B1 54 LDA ($54),Y
0344 F0 05 BEQ $0348
0346 A2 41 LDX #$41
0348 20 A0 03 JSR $03A0
034B 20 E0 03 JSR $03ED
034E 20 BA 03 JSR $03BA
0351 90 EA BCC $033D
0353 20 97 03 JSR $0397
0356 B1 54 LDA ($54),Y
0358 F0 05 BEQ $035F
035A A2 42 LDX #$42
035C 20 A0 03 JSR $03A0
035F A2 08 LDX #$08
0361 A9 01 LDA #$01
0363 91 54 STA ($54),Y
0365 01 54 CMP ($54),Y
0367 F0 00 BEQ $0376
0369 9A TXS
036A 48 PHA
036B 8A TXA
036C 20 CE 03 JSR $03CE
036F 68 PLA
0370 A2 43 LDX #$43
0372 20 A0 03 JSR $03A0
0375 BA TSX
0376 0A ASL
0377 CA DEX
0378 00 E9 BNE $0363
037A A9 FF LDA #$FF
037C 91 54 STA ($54),Y
037E 01 54 CMP ($54),Y
0380 F0 05 BEQ $0387
0382 A2 44 LDX #$44
0384 20 A0 03 JSR $03A0
0387 20 E0 03 JSR $03ED
038A 20 BA 03 JSR $03BA
038C 90 C7 BCC $0356
038F A9 2A LDA #$2A
0391 20 CA 03 JSR $03CA
0394 4C 3A 03 JMP $033A
0397 A5 3C LDA $3C
0399 85 54 STA $54
039B A5 3D LDA $3D
039D 85 55 STA $55
039F 60 RTS
03A0 48 PHA
03A1 98 TYA
03A2 48 PHA
03A3 8A TXA
03A4 20 CA 03 JSR $03CA
03A7 A5 55 LDA $55
03A9 20 CE 03 JSR $03CE
03AC A5 54 LDA $54
03AE 20 CE 03 JSR $03CE
03B1 A9 20 LDA $20
03B3 20 CA 03 JSR $03CA
03B6 68 PLA
03B7 A8 TAY
03B8 68 PLA
03B9 60 RTS
03BA A5 54 LDA $54
03BC C5 3E CMP $3E
03BE A5 55 LDA $55
03C0 E5 3F SBC $3F
03C2 60 RTS
03C3 E6 54 INC $54
03C5 D0 02 BNE $03C9
03C7 E6 55 INC $55
03C9 60 RTS
03CA 20 D2 FF JSR $FFD2
03CD 60 RTS
03CE 85 56 STA $56
03D0 4A LSR
03D1 4A LSR
03D2 4A LSR
03D3 4A LSR
03D4 20 DF 03 JSR $03DF
03D7 A5 56 LDA $56
03D9 20 DF 03 JSR $03DF
03DC A5 56 LDA $56
03DE 60 RTS
03DF 29 0F AND #$0F
03E1 C9 0A CMP #$0A
03E3 18 CLC
03E4 30 02 BMI $03E8
03E6 69 07 ADC #$07
03E8 69 30 ADC #$30
03EA 4C CA 03 JMP $03CA
03ED 20 E4 FF JSR $FFE4
03F0 F0 01 BEQ $03F3
03F2 00 BRK
03F3 4C C3 03 JMP $03C3
03F6 00 BRK
03F7 00 BRK
03F8 00 BRK
03F9 00 BRK

```

Listing 1. Test program (see Table 1).

BEGINA	033A
NEXTA	033D
INCA	034B
BEGINB	0356
WALK	035F
NEXTB	0363
SHIFT	0376
INCB	0387
INIT	0397
ERR	03A0
COMP	03BA
INC	03C3
RET	03C9
PRNT	03CA
PRBYT	03CE
HEXASC	03DF
HEXASD	03E8
STOP	03ED
GOINC	03F3

Table 3. Statement labels for Listing 1.

```

1 DATA32,151,3,169,0,168,145,84,177,84,
240,5,162,65,32,160,3,32,237,3,32,186,3
2 DATA144,234,32,151,3,177,84,240,5,162
,66,32,160,3,162,8,169,1,145,84,209,84
3 DATA240,13,154,72,138,32,206,3,104,16
2,67,32,160,3,186,10,202,208,233,169,255
4 DATA145,84,209,84,240,5,162,68,32,160
,3,32,237,3,32,186,3,144,199,169,42,32
5 DATA202,3,76,58,3,165,60,133,84,165,6
1,133,85,96,72,152,72,138,32,202,3,165,8
5
6 DATA32,206,3,165,84,32,206,3,169,32,3
2,202,3,104,168,104,96,165,84,197,62,165
7 DATA85,229,63,96,230,84,208,2,230,85,
96,32,210,255,96,133,86,74,74,74,74,32,2
23
8 DATA3,165,86,32,223,3,165,86,96,41,15
,201,10,24,48,2,105,7,105,48,76,202,3,32
9 DATA228,255,240,1,0,76,195,3
10 Y=0
20 FORI=026T01013
30 READX:POKEI,X
40 Y=Y+X:NEXT
45 PRINT"DATA CHECK SUM SHOULD BE 19554
":PRINT
50 IFV<19554THENPRINT"DATA CHECK SUM E
RROR:"Y:END
60 PRINT"DATA CHECK SUM OK:"Y:END
READY

```

Listing 2. Poker/Loader.

chips that store these pointers, swap them with chips at a higher address. When testing the video range, the screen will fill with at signs (@) and the checkerboard character (code 255), thus obscuring the asterisk until an error code is printed.

Old ROM users should note that testing RAM from 0400-076A hex will overwrite the machine-language monitor. The test itself will run, but if a key is pressed to stop the test, the PET will break to the now nonexistent monitor and it will crash.

Those with the Programmer's Tool

Kit or disk units or any other programs which use the second cassette buffer will want to make sure they are not running. Otherwise they may overwrite the test program. For the same reason, some users may not be able to copy the test program intact to disk. ■

References

"It's Here: Cook's Memory Test" (8080 version), Rod Hallen, *Microcomputing*, July 1978, p. 70.
"Memory Trouble Shooting Tech-

niques," Charles Cook, *Microcomputing*, Oct. 1977, p. 58.

Pet Machine Language Guide, Abacus Software, Grand Rapids, MI, 1979, routines WRT, GET.

PET/CBM Personal Computer Guide, Donahue and Enger, Osborne/McGraw-Hill, Berkely, CA, 1980, Memory maps—NEW, p. 334; OLD, p. 414. *PET/CBM User's Manual* (NEW ROM), routines WRT, GET & TIM, BRK, p. 116.

PET User's Manual, PET 2001-8 (OLD ROM), Oct. 1978, TIM, BRK, WRT, GET, pp. 97-111.

```

: 033A 20 97 03 A9 00 A8 91 54
: 0342 B1 54 F0 05 A2 41 20 A0
: 034A 03 20 ED 03 20 BA 03 90
: 0352 EA 20 97 03 B1 54 F0 05
: 035A A2 42 20 A0 03 A2 08 A9
: 0362 01 91 54 01 54 F0 00 9A
: 036A 48 8A 20 CE 03 68 A2 43
: 0372 20 A0 03 BA 0A CA 00 E9
: 037A A9 F7 91 54 01 54 F0 05
: 0382 A2 44 20 A0 03 20 ED 03
: 038A 20 BA 03 90 C7 A9 2A 20
: 0392 CA 03 40 3A 03 A5 3C 85
: 039A 54 A5 3D 85 55 60 48 98
: 03A2 48 8A 20 CA 03 A5 55 20
: 03AA CE 03 A5 54 20 CE 03 A9
: 03B2 20 20 CA 03 68 A8 68 60
: 03BA A5 54 C5 3E A5 55 E5 3F
: 03C2 60 E6 54 00 02 E6 55 60
: 03CA 20 D2 FF 60 85 56 4A 4A
: 03D2 4A 4A 20 0F 03 A5 56 20
: 03DA 0F 03 A5 56 60 29 0F C9
: 03E2 0A 18 30 02 69 07 69 30
: 03EA 4C CA 03 20 E4 FF F0 01
: 03F2 0A 4C C3 03 00 00 00 00
: ?

```

Table 4. Hex dump.

Variable	Hex	Decimal	Function in New ROM
STARTL	003C	60	Current DATA line number (low-order byte)
STARTh	003D	61	Current DATA line number (high-order byte)
ENDL	003E	62	Current DATA line pointer (low-order byte)
ENDH	003F	63	Current DATA line pointer (high-order byte)
POINTL	0054	84	Floating point accumulator #3
POINTH	0055	85	Floating point accumulator #3
TEMP	0056	86	Floating point accumulator #3

Table 5. All variables are within the old ROM BASIC input buffer.

Routine	New ROM	Old ROM	Function in both ROMs
WRT	FFD2	FFD2	Write a character to the screen
GET	FFE4	FFE4	Get a character from keyboard; set status
READY	C389	C389	BASIC warm start
TIM	FD17	0427	Warm entry point for TIM
BRK	0092	021B	BRK interrupt vector location (low byte)
	0093	021C	BRK interrupt vector location (high byte)

Table 6. External routines.

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Heath's Hidden Time-Saver

By Charles E. Cohn

Many applications require that the current date be shown on the printout. The program can, of course, have you enter the date. But if the operating system has already called for the date to be entered, it is much more convenient to extract the information internally, and save you the bother of entering the date a second time.

If you use a Heath H8 or H-89 with Benton Harbor BASIC and HDOS, it is easy to extract that information. HDOS stores the date in two different forms. First, and most straightforward, the nine bytes starting at location 8383 contain the date in alphanumeric in the form in which it was en-

tered; e.g., 30-Oct-80. Even though the month may have been entered either in upper- or lowercase, the first letter of the month as stored is always capitalized, and the remaining two letters are stored as lowercase.

This information can be extracted as shown in Listing 1, which prints out the date just as stored. Variations

are possible; you can, for example, drop off the hyphens or change the order of the month and the day.

If you wish to do something fancier, such as print the full name of the month, you might want to use the date in the other form in which it is stored, i.e., in binary at locations 8392 and 8393. The low-order five bits of the byte at 8392 give the day, while the high-order three bits are the low-order part of the four-bit month. The low-order bit of the byte at 8393 is the high-order part of the month, while the remaining bits of that byte give the year minus 1970. This information can be used as shown in Listing 2, which prints the date in the form October 30, 1980. ■

```
00010 D$=""
00020 FOR I=1 TO 9:D$=D$+CHR$(PEEK(8382+I)):NEXT I
00030 PRINT D$
00040 END
```

Listing 1.

```
00010 N1=PEEK(8392):N2=PEEK(8393):N3=INT(N1/32):N4=INT(N2/2)
00020 D=N1-N3*32
00030 M=N3+N2*8-N4*16
00040 Y=N4+1970
00050 FOR I=1 TO M:READ M$:NEXT I
00060 DATA January,February,March,April,May,June,July
00070 DATA August,September,October,November,December
00080 D$=STR$(D)
00090 PRINT M$+LEFT$(D$,LEN(D$)-1)+",";Y
00100 END
```

Listing 2.

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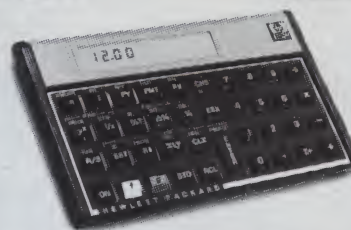
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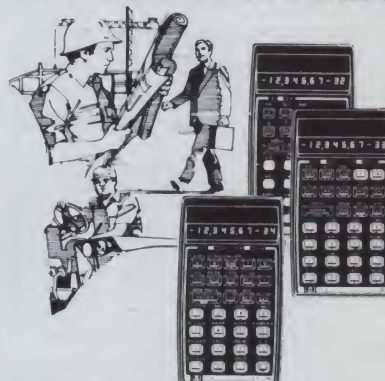
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Power Jump For the 1802

By Brian McCorkle

This feature for 1802-based systems lets you jump to the monitor when you turn the power on. It eliminates the reset/load/reset/run sequence necessary to bootstrap the address of your monitor. An added switch contact lets you jump to the monitor from a running (crashing)

program. You can also add a switch to let you run at address zero. The circuitry required to do this is quite simple.

You need a self-latching monitor in ROM, and the ROM must be entered with register zero as the program counter.

The jump circuit cycles the 1802 through reset and into run. It also temporarily disables RAM at address #0000 and places the monitor at that address. The first memory write pulse resets the circuit and the system returns to normal operation.

IC1 is the 1802 (Fig. 1). Pin 2(wait) is tied to the 5-V supply. Pin 3(clear) is then used to set IC1 in the reset or run mode.

IC2, R1, R2, R3 and C1 is the reset run portion of the circuit. When you turn on the power the output of IC2 remains low for about 60 ms, holding IC1 in reset. IC2 then goes high, placing IC1 in the run mode. S1 is used to start this sequence from a running program. D1 provides for rapid discharge of C1 if power is lost.

The output of IC2 is also sent to IC3, which disables the RAM at #0000 and transfers the monitor to this location. IC3 is a 555 timer in the

monostable mode, and its period is fairly long; but in practice it is reset by the first memory write pulse.

The output of IC3 is a high level which drives an OR circuit, consisting of D1, D2, and R5, high. This signal is also used to switch IC4, so a low level is placed on the chip enable of the monitor ROM.

S2 is a run at zero switch. S2A does the same thing as S1. S2B times IC3 out before the reset period is done so no memory switching takes place.

As mentioned, the monitor must be self-latching. Listing 1 gives a way to go about this. The Quest monitor V1.1 does work, and the VIP monitor should also work.

The layout of this project is not critical. The prototype was wire-wrapped and distributed over several boards.

In case you have trouble, first check for shorts and opens. Then be sure all COME-FROMs and GOTOs match.

If this doesn't correct the problem, temporarily place a 10 μ F capacitor in parallel with C1. The output of IC2 should stay low for about one-half second after power on or S1 depression. The output should then go high. The output of IC3 should go high during this period and drop low shortly thereafter. If this output remains high for ten seconds, then IC3 is not being reset by a memory write pulse. Finally, the cathode of D1 should be a high level and pins 3 and 11 of IC4 should be a low level.

This simple circuit will eliminate a great deal of key punching. I have found it a great convenience well worth building into a system. ■

Parts List

C1	1 μ F tantalum
C2	.01 μ F ceramic
C3	10 μ F tantalum
D1,2,3	1N914
IC1	1802
IC2	4050 hex buffer
IC3	555 timer
IC4	4066 quad switch
R1,5	47k ohm
R2,6	22k ohm
R3	100k ohm
R4	1 megohm
all resistors 1/4 watt 5 percent	
S1	1 pole, normally open momentary contact
S2	2 pole, normally open momentary contact

Fig. 1. The hardware required for a power-on jump to monitor.

At start Register 0 is at 0000.

4000 F840 LDI #40

40 is example. This number is determined by ROM location.

4002 B0 PHI RO

Register 0 now at 4003.

4003 F82FB2 LDI #2F, PHI R2

4006 F8FFA2 LDI #FF, PLO R2

4009 E2 SEX R2

Locate data pointer to free location.

400A 73 STXD

Memory write to reset timer.

etc.

Listing 1. Example of the requirement of the ROM to latch its own address and reset the timer with a memory write pulse. The addresses given are examples. Actual values will depend on where your ROM is located.

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MICRO QUIZ

(from page 22)

Answer: 67

This program finds the index of the rightmost occurrence of the string LS within the string SS.

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For more information contact Dr. Linda Leffel, CEC., VPI and SU, Blacksburg, VA 24061. 703-961-4848.

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The Robots VI Conference and Exposition will be held March 1-4 in Detroit, MI. Contact RI/SME, One SME Drive, PO Box 930, Dearborn, MI 48128. 313-271-1500, ext. 416.

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For more information write Catalyst Conference, H 112, Jersey City State College, 2039 Kennedy Blvd., Jersey City, NJ 07305.

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For more information write Software/Expo-West, Suite 400, 222 West Adams St., Chicago, IL 60606. 312-263-3131.

Seventh West Coast Computer Faire

The seventh West Coast Computer Faire will be held March 19-21 in San Francisco, CA. Contact Laurie McLean, 333 Swett Road, Woodside, CA 94062. 415-851-7075.

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Videotext '82 will be held April 12-16 in New York City. Contact Steve Weissman, Information Gatekeepers, Inc., 167 Corey Road, Brookline, MA 02146. 617-739-2022.

Symposium on Security and Privacy

The 1982 Symposium on Security and Privacy, sponsored by the IEEE Computer Society, will take place on April 26-28, 1982, at the Claremont Hotel in Oakland/Berkeley, CA.

Papers and proposals for panel sessions related to security and privacy are being solicited. Possible topics include encryption, database security, operating system and privacy protection.

Submit for review by Feb. 1, 1982, six copies of your paper or panel proposal to Dr. Peter Neumann, SRI International EL301, 333 Ravenswood Ave., Menlo Park, CA 94025.

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Deadline for abstracts is March 26, 1982. Abstracts, including author's name, title, company, address, phone and telex, should be submitted as soon as possible to William D. Ashman, Program Coordinator—Peripheral '82, Cahners Exposition Group, 222 W. Adams St., Chicago, IL 60606.

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A workshop on the automotive applications of microprocessors sponsored by the Industrial Electronics Society of IEEE will be held Oct. 7 and 8, 1982, at the Hyatt Regency Hotel, Dearborn, MI.

The workshop will focus on applications of microprocessors to automobiles, trucks, vans and allied automotive products.

Papers are being solicited for presentations at the workshop. Those interested in presenting a paper at the workshop should submit two copies of a 300-500 word summary (double-spaced) to John G. Neuman, Technical Program Chairman, General Motors Research Labs, Electrical Engineering Dept., GM Technical Center, Warren, MI 48090, by Feb. 15.

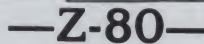
The Sixth Western Educational Computing Conference

The sixth Western Educational Computing Conference will be held in San Diego, CA, on Nov. 18 and 19, 1982, under the sponsorship of the California Educational Computing Consortium.

Original papers dealing with computers and computer applications in any area that might be of interest to instructors and administrators who use computers at the college or university level should be sent no later than March 1, 1982, to Professor Grant, Center for Information and Communications Study, California State University, Chico, CA 95929. They should be typed, double-spaced and approximately 1500 words in length. The title page of each paper must contain the author's name, complete mailing address and telephone number. A brief abstract should precede the text.

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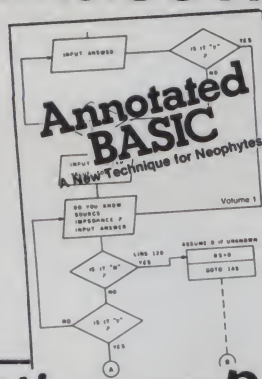
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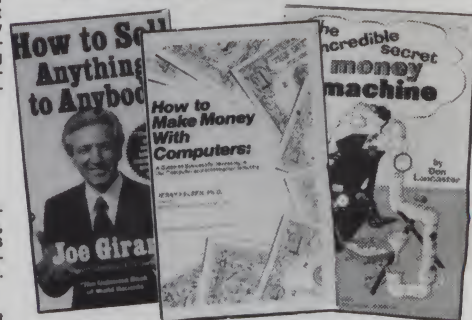
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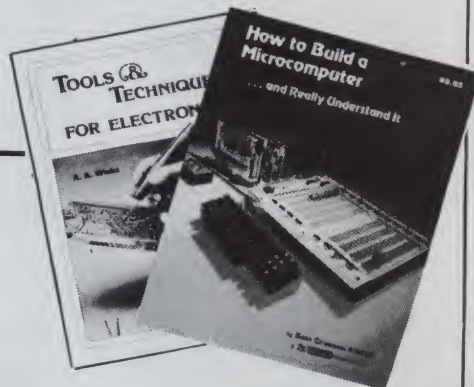
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74LS92			


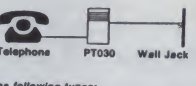
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CA3163H	3.25	CA3213N	3.25	CA3243H	3.75
CA3164H	3.25	CA3214N	3.25	CA3244H	3.75
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CA3188H	3.25	CA3238N	3.25	CA3268H	3.75
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CA3197H	3.25	CA3247N	3.25	CA3277H	3.75
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when you could be using

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for as low as \$1.94 each?

Find the flexible disc you're now using on our cross reference list... then write down the equivalent Memorex part number you should be ordering.

Product Family	Product Description	Memorex Part Number (3201-1)	CE Quant. 100 price per disc (\$)	Athana	BASF	Dysan	IBM	Maxell	Nashua	Scotch 3M	Shugart	Syncom	Verbatim	Wabash	Control Data
Flexible Disc 1s Single Headed Drives Single Density Media	IBM Compatible 1128 B/S 26 Sectors	3060	1.99	473071	543428	800566	2305830	FD1 128	FD 1	740 0	S/A 100	15002	FD34 8000	F111111X	421602
	IBM Compatible 1128 B/S 26 Sectors w/ W.P.N.	3067	2.04							740 0			FD34 8000		
	IBM Compatible 1128 B/S 26 Sectors REVERSE SIDE	3064	2.39										FD34 8000		
	IBM System 8 Compatible	1179	3.19	473072	54431	800509	1669958		FD 2	740 0 066		15150	FD34 8000	F111111X	
	IBM Compatible 1256 B/S 15 Sectors	3068	2.04	473077	54561					740 0 066		15003	FD34 8000	F111111X	
	IBM Compatible 1512 B/S 8 Sectors	3109	1.99	473073		800584	2305845			740 3600		15005	FD34 8000	F112111X	
	Shugart Compatible 32 Hard Sector	3110	1.99	473074		800585	1669954					15004	FD34 8000	F112111X	
	Wang Compatible 32 Hard Sector w/Hub Ring	3015	1.99	470901	53802	10171		FD1 32	FD 132	740 32	S/A 101	15025	FD32 8000		421322
	CP1 8000 Compatible	3087	2.49		54491					740 32RH				F374411X	
		3045	2.89									15226			
Flexible Disc 1d Single Headed Drives Double Density Media	IBM Compatible 1128 B/S 26 Sectors	3090	2.69	474071	54568	3740 10		FD1 128/M3100	FD 10	741 0			FD34 8000	F131111X	423002
	Shugart Compatible 32 Hard Sector	3093	3.69												
	Shugart Compatible 32 Hard Sector	3091	2.69	470801	54595	101 10		FD1 320		741 32	S/A 103	15075	FD32 8000	F334411X	423322
	Wang Compatible 32 Hard Sector w/Hub Ring	3088	3.09												
Flexible Disc 2s Double Headed Drives Single Density Media	Soft Sector 1128 B/S 26 Sectors	3113	3.09		54428	800814	1766870				S/A 180	15153	FD10 4026	F121111X	
	Soft Sector 1256 B/S 15 Sectors	3106	3.09	473477	54226	800815	2736700	FD2 2560		742 0		15154	FD10 4015	F122111X	424612
Flexible Disc 2d Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3102	3.09	473485		DY150		FD2 2560	FD 20	742 0		15103	FD34 4001		429002
	Soft Sector 1128 B/S 26 Sectors	3118	3.09								S/A 190				
	Soft Sector 1256 B/S 26 Sectors	3103	3.09	473471	54325	800817	1766872	FD2 2560		742 0/256		15101	FD34 4026	F144111X	429602
	Soft Sector 1512 B/S 15 Sectors	3114	3.09	473472	54479	800818	1668044			743 0/512		15100	FD34 4015	F145111X	429612
	Soft Sector 1024 B/S 8 Sectors	3104	3.09	473473	54485	800819	1668045			743 0/1024		15102	FD34 4008	F147111X	429622
	32 Hard Sector	3105	3.09	470851		101709		FD2 320		743 32	S/A 181	15128	FD32 4000	F344411X	429322
	Burroughs 840 Compatible 32 Hard Sector	3092	3.09												
	Soft Sector 1024 B/S 8 Sectors w/Hub Ring	3116	3.49												
	Shugart Compatible 32 Hard Sector	3181	3.39										FD32 4000		
Flexible Disc 8D Memorex 851 or Equiv Drive Compatible	FD in Vinyl Jacket	30712003	2.69	470851		FDV			FD-165	511 0		15026	FD65 1000	F61A111X	
Mini Flexible Disc 1s 5 1/4" Single Headed Drives Single Density Media	Soft Sector (Unformatted)	3401	1.94	475001	54256	104 1		MD1	MD 1	744 0	S/A 104	15300	MD625-01	M11A211X	461002
	16 Hard Sector	3402	1.94	475010	54257	107 1			MD 110	744 10	S/A 107	15328	MD625-10	M61A211X	461102
	Soft Sector (Unformatted) w/Hub Ring	3405	1.94	475016	54258	105 1		MD1	MD 116	744 16	S/A 106	15326	MD625-16	M51A211X	461182
	10 Hard Sector w/Hub Ring	3431	2.14										MD625-01		
	10 Hard Sector w/Hub Ring	3433	2.14										MD625-10		
	16 Hard Sector w/Hub Ring	3435	2.14										MD625-16		
Mini Flexible Disc 1d 5 1/4" Single Headed Drives Double Density Media	Soft Sector (Unformatted)	3417	2.14		54666	104 10							MD625-01		
	10 Hard Sector	3416	2.14		54649	107 10							MD625-10		
	16 Hard Sector	3418	2.14		54652	106 10							MD625-16		
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34										MD625-01		
	10 Hard Sector w/Hub Ring	3483	2.34										MD625-10		
	16 Hard Sector w/Hub Ring	3485	2.34										MD625-16		
Mini Flexible Disc 2d 5 1/4" Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3421	2.59		54624	104 20					S/A 154		MD550-01		
	10 Hard Sector	3423	2.59		54627	107 20					S/A 157		MD550-10		
	16 Hard Sector	3425	2.59		54630	106 20					S/A 155		MD550-16		
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79										MD550-01		
	10 Hard Sector w/Hub Ring	3493	2.79										MD550-10		
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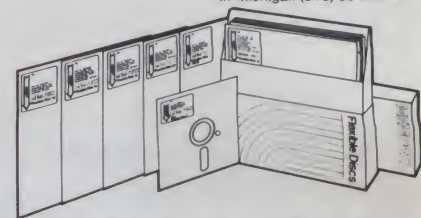
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7402N	19 <th>LM320K-1</th> <td>1.49</td> <td>CD4019</td> <td>45</td> <td>8191</td> <td>7.50</td> <td>DA155</td> <td>2.10</td>	LM320K-1	1.49	CD4019	45	8191	7.50	DA155	2.10
7404N	22 <th>LM320K-1.5</th> <td>1.35</td> <td>CD4020</td> <td>90</td> <td>8198</td> <td>1.65</td> <td>DA155</td> <td>3.10</td>	LM320K-1.5	1.35	CD4020	90	8198	1.65	DA155	3.10
7409N	19 <th>LM320K-1.2</th> <td>1.35</td> <td>CD4021</td> <td>95</td> <td></td> <td></td> <td>Complete Set</td> <td>29.95</td>	LM320K-1.2	1.35	CD4021	95			Complete Set	29.95
7410N	19 <th>LM320K-1.5</th> <td>1.35</td> <td>CD4022</td> <td>110</td> <td></td> <td></td> <td>Stepswitch Kit</td> <td>17.95</td>	LM320K-1.5	1.35	CD4022	110			Stepswitch Kit	17.95
7414N	55 <th>LM320T-5</th> <td>95</td> <td>CD4023</td> <td>28</td> <td></td> <td></td> <td>Digital Clock Kit</td> <td>19.75</td>	LM320T-5	95	CD4023	28			Digital Clock Kit	19.75
7420N	19 <th>LM320T-1</th> <td>95</td> <td>CD4024</td> <td>25</td> <td></td> <td></td> <td></td> <td></td>	LM320T-1	95	CD4024	25				
7430N	18 <th>LM320T-1.2</th> <td>95</td> <td>CD4025</td> <td>23</td> <td>2102-1</td> <td>85</td> <td>2708</td> <td>3.95</td>	LM320T-1.2	95	CD4025	23	2102-1	85	2708	3.95
7442N	49 <th>LM320T-1.5</th> <td>95</td> <td>CD4026</td> <td>1.65</td> <td>2102AL-4</td> <td>1.45</td> <td>2716 5 Volt</td> <td>5.75</td>	LM320T-1.5	95	CD4026	1.65	2102AL-4	1.45	2716 5 Volt	5.75
7447N	69 <th>LM324N</th>	LM324N	4.95	CD4027	85	2102AM-2L	4.95	82716 5 Volt	39.00
7448N	69 <th>LM339N</th>	LM339N	99	CD4028	80	2104A-4	3.75	2732	16.50
7449N	69 <th>LM339N</th>	LM339N	99	CD4029	95	2107E-4	3.75	2738	7.49
7474N	49 <th>LM340K-8</th> <td>3.35</td> <td>CD4035</td> <td>85</td> <td>2112-2</td> <td>2.99</td> <td>8741A</td> <td>39.95</td>	LM340K-8	3.35	CD4035	85	2112-2	2.99	8741A	39.95
7485N	65 <th>LM340K-15</th> <td>3.35</td> <td>CD4040</td> <td>85</td> <td>2114-1</td> <td>2.4</td> <td>8750A</td> <td>49.95</td>	LM340K-15	3.35	CD4040	85	2114-1	2.4	8750A	49.95
7489N	170 <th>LM340T-15</th> <td>3.35</td> <td>CD4042</td> <td>75</td> <td>2114 300ms</td> <td>2.50</td> <td>8748B</td> <td>55.00</td>	LM340T-15	3.35	CD4042	75	2114 300ms	2.50	8748B	55.00
7490N	35 <th>LM340T-24</th> <td>3.35</td> <td>CD4043</td> <td>85</td> <td>2114 450ms</td> <td>2.37</td> <td>8752A</td> <td>55.00</td>	LM340T-24	3.35	CD4043	85	2114 450ms	2.37	8752A	55.00
74100N	100 <th>LM340T-8</th> <td>85</td> <td>CD4046</td> <td>95</td> <td>8116 200ms</td> <td>1.50</td> <td>N87523</td> <td>2.95</td>	LM340T-8	85	CD4046	95	8116 200ms	1.50	N87523	2.95
74107N	35 <th>LM340T-12</th> <td>85</td> <td>CD4049</td> <td>45</td> <td>8116 200ms</td> <td>1.50</td> <td>N87523</td> <td>3.95</td>	LM340T-12	85	CD4049	45	8116 200ms	1.50	N87523	3.95
74123N	55 <th>LM340T-15</th> <td>85</td> <td>CD4050</td> <td>50</td> <td>MM5320</td> <td>3.50</td> <td>N87526</td> <td>7.75</td>	LM340T-15	85	CD4050	50	MM5320	3.50	N87526	7.75
74125N	45 <th>LM340T-18</th> <td>85</td> <td>CD4051</td> <td>95</td> <td>MM5330</td> <td>3.94</td> <td>N87529</td> <td>4.75</td>	LM340T-18	85	CD4051	95	MM5330	3.94	N87529	4.75
74149N	60 <th>LM340T-24</th> <td>85</td> <td>CD4060</td> <td>142</td> <td>PS101L</td> <td>8.95</td> <td>N87531</td> <td>8.75</td>	LM340T-24	85	CD4060	142	PS101L	8.95	N87531	8.75
74150N	120 <th>LM350</th>	LM350	5.50	CD4066	71	4200A	11.50	N87536	8.75
74151N	65 <th>LM357</th>	LM357	2.20	CD4068	39	410D	10.00	N87537	8.75
74154N	125 <th>LM359N</th>	LM359N	100	CD4069	40	410D	10.00	8723	3.50
74157N	55 <th>LM381</th>	LM381	1.60	CD4070	35	410D	10.00		
74161N	70 <th>LM382</th>	LM382	1.60	CD4071	35	410D	10.00		
74162N	85 <th>LM382N</th>	LM382N	59	CD4072	30	CLOCKS			
74163N	85 <th>LM382N</th>	LM382N	59	CD4073	30	MM5311	4.95	LEDS	
74174N	89 <th>LM373N</th>	LM373N	85	CD4075	30	MM5312	3.95	Red T018	15
74175N	85 <th>LM374CH</th>	LM374CH	35	CD4076	95	MM5314	3.95	Green, Yellow T018	25
74190N	115 <th>LM741N</th>	LM741N	100	CD4078	30	MM5369	1.95	Green, Yellow Jumbo	25
74192N	79 <th>LM747N</th>	LM747N	75	CD4081	30	MM5841	14.45	Green LED Mounting Clips	8.575
74193N	79 <th>LM748N</th>	LM748N	75	CD4082	30	MM5855	9.95	(Spec. red amber green yellow clear)	
74221N	125 <th>LM303N</th>	LM303N	175	CD4116	47	CT1010	8.95	CONTINENTAL SPECIALTIES in sheet	
74298N	85 <th>LM304</th>	LM304	110	CD4490	5.50	CT7015	9.95	Complete line of breadboard test equip	
74365N	65 <th>LM305N</th>	LM305N	125	CD4507	99 <td>MM5373AAG N</td> <td>9.90</td> <td>DK WRAP TOOLS in stock</td> <td></td>	MM5373AAG N	9.90	DK WRAP TOOLS in stock	
74366N	65 <th>LM307</th>	LM307	110	CD4508	1.95 <td>MM5373AG N</td> <td>4.90</td> <td>Complete line of AP Products in stock</td> <td></td>	MM5373AG N	4.90	Complete line of AP Products in stock	
74367N	65 <th>LM310</th>	LM310	7.75	CD4510	95	7205	16.50		
						7207	15.95		
						CD4515	2.75	7208	15.95
						CD4516	1.25	7209	15.95
						CD4518	1.75	7210	15.95
						CD4520	1.02	8502	9.95
						CD4527	3.50	8504	9.95
						CD4528	1.25	8505	9.95
						CD4533	3.50	8506	9.95
						CD4534	3.50	8507	9.95
						CD4535	3.50	8508	9.95
						CD4536	3.50	8509	9.95
						CD4537	3.50	8510	9.95
						CD4538	3.50	8511	9.95
						CD4539	3.50	8512	9.95
						CD4540	3.50	8513	9.95
						CD4541	3.50	8514	9.95
						CD4542	3.50	8515	9.95
						CD4543	3.50	8516	9.95
						CD4544	3.50	8517	9.95
						CD4545	3.50	8518	9.95
						CD4546	3.50	8519	9.95
						CD4547	3.50	8520	9.95
						CD4548	3.50	8521	9.95
						CD4549	3.50	8522	9.95
						CD4550	3.50	8523	9.95
						CD4551	3.50	8524	9.95
						CD4552	3.50	8525	9.95
						CD4553	3.50	8526	9.95
						CD4554	3.50	8527	9.95
						CD4555	3.50	8528	9.95
						CD4556	3.50	8529	9.95
						CD4557	3.50	8530	9.95
						CD4558	3.50	8531	9.95
						CD4559	3.50	8532	9.95
						CD4560	3.50	8533	9.95
						CD4561	3.50	8534	9.95
						CD4562	3.50	8535	9.95
						CD4563	3.50	8536	9.95
						CD4564	3.50	8537	9.95
						CD4565	3.50	8538	9.95
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						CD4570	3.50	8543	9.95
						CD4571	3.50	8544	9.95
						CD4572	3.50	8545	9.95
						CD4573	3.50	8546	9.95
						CD4574	3.50	8547	9.95
						CD4575	3.50	8548	9.95
						CD4576	3.50	8549	9.95
						CD4577	3.50	8550	9.95
						CD4578	3.50	8551	9.95
						CD4579	3.50	8552	9.95
						CD4580	3.50	8553	9.95
						CD4581	3.50	8554	9.95
						CD4582	3.50	8555	9.95
						CD4583	3.50	8556	9.95
						CD4584	3.50	8557	9.95
						CD4585	3.50	8558	9.95
						CD4586	3.50	8559	9.95
						CD4587	3.50	8560	9.95
						CD4588	3.50	8561	9.95
						CD4589	3.50	8562	9.95
						CD4590	3.50	8563	9.95
						CD4591	3.50	8564	9.95
						CD4592	3.50	8565	9.95
						CD4593	3.50	8566	9.95
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						CD4602	3.50	8575	9.95
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						CD4646	3.50	8619	9.95
						CD4647	3.50	8620	9.95
						CD4648	3.50	8621	9.95
						CD4649	3.50	8622	9.95
						CD4650	3.50	8623	9.95
						CD4651	3.50	8624	9.95

COMPONENTS

SN7400N	18	SN7482N	30
SN7402N	22	SN7483N	45
SN7404N	21	SN7484N	45
SN7408N	22	SN7485N	60
SN7410N	18	SN7486N	60
SN7412N	20	SN74122N	39
SN7413N	22	SN74130N	60
SN7414N	26	SN74141N	60
SN7416N	27	SN74151N	65
SN7417N	29	SN74153N	95
SN7420N	17	SN74154N	125
SN7425N	20	SN74155N	75
SN7430N	17	SN74157N	58
SN7437N	26	SN74160N	60
SN7438N	24	SN74161N	65
SN7440N	18	SN74163N	65
SN7442N	45	SN74164N	67
SN7443N	42	SN74165N	55
SN7445N	64	SN74174N	60
SN7451N	19	SN74175N	79
SN7454N	19	SN74180N	75
SN7474N	27	SN74181N	115
SN7475N	35	SN7493N	165

74LS00

74LS00	28	74LS158	60
74LS02	28	74LS161	83
74LS03	28	74LS162	80
74LS04	28	74LS163	98
74LS05	22	74LS164	65
74LS08	29	74LS165	65
74LS09	28	74LS169	67
74LS10	26	74LS170	175
74LS14	86	74LS174	65
74LS20	22	74LS175	125
74LS21	26	74LS180	85
74LS26	40	74LS181	125
74LS27	27	74LS186	90
74LS28	37	74LS197	78
74LS30	29	74LS221	125
74LS32	31	74LS240	185
74LS38	31	74LS241	185
74LS42	63	74LS243	155
74LS46	77	74LS244	156
74LS47	38	74LS245	245
74LS48	55	74LS251	125
74LS49	45	74LS253	85
74LS50	56	74LS257	85
74LS53	85	74LS259	195
74LS58	80	74LS260	55
74LS107	43	74LS273	155
74LS113	45	74LS279	45
74LS122	45	74LS290	125
74LS123	88	74LS293	165
74LS125	88	74LS305	65
74LS126	79	74LS367	75
74LS138	64	74LS373	145
74LS139	59	74LS378	145
74LS151	48	74LS377	125
74LS153	49	74LS369	155
74LS157	60	74LS370	185

74S00

74S00	39	74S138	75
74S02	45	74S140	100
74S03	38	74S158	75
74S04	39	74S174	135
74S06	39	74S175	135
74S10	39	74S182	75
74S15	45	74S189	425
74S20	55	74S201	675
74S22	55	74S240	275
74S30	75	74S244	296
74S37	55	74S251	275
74S50	65	74S287	296
74S51	49	74S288	296
74S64	55	74S299	575
74S74	65	74S373	925
74S86	95	74S471	950
74S112	195	74S473	950
74S132	145	74S474	950

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2732	12.95sec	4 for 11.00sec
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	200NS	2.35sec 8 for 16.00
2714L	300NS	2.25sec 4 for 19.00
	200NS	2.45sec 4 for 2.00sec
2711	450NS	2.50sec 10 for 2.00sec

MISC.

2102			cont'd	
450NS	95			
8038	2.95	1103A	.75	
ME565	27	UPD785	16.95	
AY5-1013A	4.25	poppy disk	w tape	
1489	95	controller		
1489	95	ULN2001	1.95	
8728	1.30	TMS4400	1.40	
8728	1.30	MC4008B	9.50	
8218	1.95	MH0026	1.55	
8218	1.95	D3654	1.95	
8410BCR	85	D3001	1.95	
17410TRIAC	85	D3002	1.95	
7908	85			
7908	85			
7915	85			
7918	85			
7908	85			
7908	85			
7912	85			
MC1330AP	1.60	10/5.30	14	10/1.30
MC1330P	1.15	10/5.70	16	10/1.40
MC1358P	1.50	10/9.70	20	10/2.70
LM380	1.10	10/12.70	22	10/2.70
LM566N	95	10/13.70	24	10/2.70
LM741	25	10/14.70	28	10/3.00
MC1458P	55	10/17.70	40	10/3.90
LM720	30	wirewrap	solder	
LM386	1.30			

CPU's

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FOR AIM-65, SYM-1



The VAK-7 Disk System was specifically designed for use with AIM-65 and SYM-1 Microcomputer Systems. The VAK-7 is a complete full size (8") Floppy Disk System. This system will Read, Write and Format IBM Single and Dual Density diskettes. The VAK-7 is available with both Single and Dual Sided Disk Drives. Each Disk Drive comes with its own cabinet and Power Supply. The VAK-7 can handle up to 4 disk drives, totaling more than 4.98 Megabytes of storage.

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AIM-65—Allows the user to save and load object code thru the AIM Monitor; to load, save, and append Text thru the AIM Editor; to load, save, and append Basic Programs thru the BASIC INTERPRETER; to assemble directly from *disk single or multiple file programs*.

SYM-1—Allows the user to save and load Files for use with the SYM Monitor, SYM Basic, and RAE-1.

ADDITIONAL COMMANDS:

ACTIVATE A DELETED FILE
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RENAME A DISK FILE
COPY A DISK

FORMAT A DISK
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INITIALIZE A DISK
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SPECIFICATIONS:

- Completely assembled, tested, and burned in.
- Occupies address 8000-8FFF for AIM-65, \$9000-9FFF for SYM-1, or \$E000-EFFF for KIM-1.
- IBM Format; Single Density (128 bytes/sector); Dual Density (256,512, or 1024 bytes/sector).
- All ICs are in sockets.
- Fully buffered address and data bus.
- Standard KIM-4* BUS (both electrical pin-out and card size).
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- Dimensions: Board—10" wide x 7" high (including card-edge). Cabinet—9.25" wide x 10" high x 16" deep.
- Power Requirements: +5v DC @ 2 Amps.
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*KIM-4 is a product of MOS Technology/C.B.M.

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SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

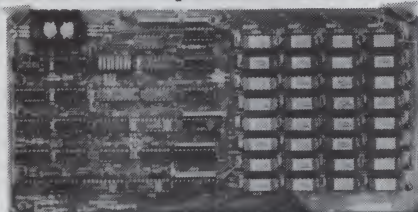
\$995.00

4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

-All boards are assembled and tested-

ExpandoRAM III

64K to 256K expandable RAM board



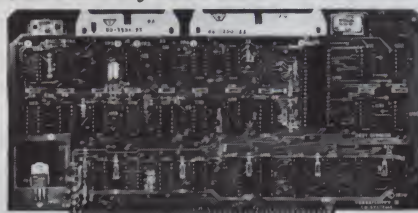
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dynamic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A	64K A & T	\$495.00
MEM-65128A	128K A & T	\$639.95
MEM-65192A	192K A & T	\$769.95
MEM-65256A	256K A & T	\$879.95

Versafloppy II

Double density controller with CP/M 2.2



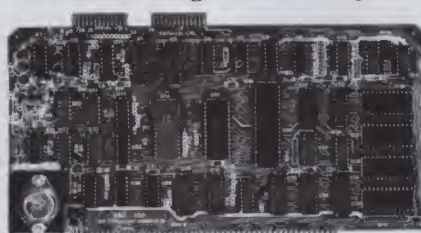
- S-100 bus compatible • IBM 3740 compatible soft sector format • Controls single and double-sided drives, single or double density, 5 1/4" and 8" drives in any combination of four simultaneously
- Drive select and side select circuitry • Analog phase-locked loop data separator • Vectored interrupt operation optional • CP/M 2.2 disk and manual set included • Control/diagnostic software PROM included

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IOD-1160A A & T with CP/M 2.2 .. \$370.00

SBC-200

2 or 4 MHz single board computer



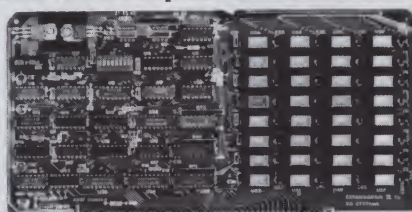
- S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A A & T with monitor .. \$299.95

ExpandoRAM II

16K to 64K expandable RAM board



- S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

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MEM-48632A	48K A & T	\$365.00
MEM-64633A	64K A & T	\$385.00

COSMOS

Multi-user operating system

- Multi-user disk operating system • Allows up to 8 users to run independent jobs concurrently • Each user has a separate file directory

COSMOS supports all the file structures of CP/M 2.2, and is compatible at the applications program level with CP/M 2.2, so that most programs written to run under CP/M 2.2 or SDOS will also run under COSMOS.

SFC-55009039F COSMOS on 8" disk \$395.00

Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

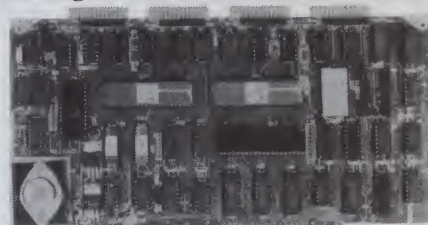
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-All boards are assembled and tested-

MPC-4

Intelligent communications interface



- Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

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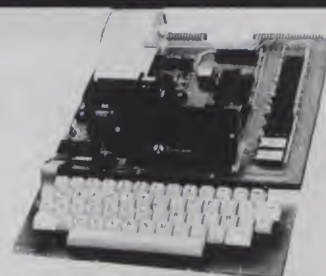
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CPU-30200B Bare board	\$35.00

2810 Z-80* CPU - Cal Comp Sys

2/4 MHz Z-80A* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.

CPU-30400A A & T	\$269.95
------------------	----------

CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K Kit	\$239.95
CPU-30300A A & T	\$299.95

S-100 PROM Boards

PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer w/software

MEM-99520K Kit	\$189.95
MEM-99520A A & T	\$249.95

PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K Kit	\$154.95
MEM-99510A A & T	\$219.95

EPROM BOARD - Jade

16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K Kit	\$79.95
MEM-16230A A & T	\$119.95

S-100 Video Boards

VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit	\$349.95
IOV-1095A 4 MHz A & T	\$439.95
IOV-1096K 80 x 48 upgrade	\$39.95

VDB-8024 - SD Systems

80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A*.

IOV-1020A A & T	\$459.95
-----------------	----------

VIDEO BOARD - S.S.M.

64 characters x 16 lines, 128 x 48 matrix for graphics, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K Kit	\$149.95
IOV-1051A A & T	\$219.95
IOV-1051B Bare board	\$34.95

S-100 Motherboards

ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard
6 Slot (5 1/4" x 8")

MBS-061B Bare board	\$19.95
MBS-061K Kit	\$39.95
MBS-061A A & T	\$49.95

12 Slot (9 1/4" x 8")

MBS-121B Bare board	\$29.95
MBS-121K Kit	\$69.95
MBS-121A A & T	\$89.95

18 Slot (14 1/2" x 8")

MBS-181B Bare board	\$49.95
MBS-181K Kit	\$99.95
MBS-181A A & T	\$139.95

S-100 RAM Boards

MEMORY BANK - Jade

4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B Bare Board	\$49.95
MEM-99730K Kit no RAM	\$199.95
MEM-32731K 32K Kit	\$239.95
MEM-64733K 64K Kit	\$279.95
Assembled & Tested	add \$50.00

64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A A & T	\$575.00
------------------	----------

64K STATIC RAM - Mem Merchant

64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A A & T	\$789.95
------------------	----------

32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 2114's

MEM-16151K 16K 4 MHz kit	\$169.95
MEM-32151K 32K 4 MHz kit	\$299.95
Assembled & tested	add \$50.00

16K STATIC RAM - Mem Merchant

4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A A & T	\$164.95
------------------	----------

S-100 Disk Controllers

DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit	\$299.95
IOD-1200A A & T	\$375.00
IOD-1200B Bare board	\$59.95

DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2* and manual set.

IOD-1300A A & T	\$374.95
-----------------	----------

S-100 I/O Boards

S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K 2 CTC's, 1 SIO, 1 PIO	\$179.95
IOI-1045A A & T	\$239.95
IOI-1046K 4 CTC's, 2 SIO's, 1 PIO	\$219.95
IOI-1046A A & T	\$299.95
IOI-1045B Bare board w/ manual	\$49.95

I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K Kit	\$179.95
IOI-1010A A & T	\$249.95
IOI-1010B Bare board	\$35.00

S-100 Mainframes

MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

ENC-112105 Kit	\$329.95
ENC-112106 A & T	\$399.95

DISK MAINFRAME - N.P.C.

Holds 2 8" drives and a 12 slot S-100 system. Attractive metal cabinet with 12 slot motherboard & card cage, power supply, dual fans, lighted switch, and other professional features

ENS-112325 with 25 amp p.s.	\$699.95
-----------------------------	----------

Disk Drives



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

Dual 8" Subassembly Cabinet

END-000420 Bare cabinet	\$59.95
END-000421 Cabinet kit	\$225.00
END-000431 A & T	\$359.95

8" Disk Drive Subsystems

Single Sided, Double Density

END-000423 Kit w/2 FD100-8Ds	\$924.95
END-000424 A & T w/2 FD100-8Ds	\$1124.95
END-000433 Kit w/2 SA-801Rs	\$999.95
END-000434 A & T w/2 SA-801Rs	\$1195.00

8" Disk Drive Subsystems

Double Sided, Double Density

END-000426 Kit w/2 DT-8s	\$1224.95
END-000427 A & T w/2 DT-8s	\$1424.95
END-000436 Kit w/2 SA-851Rs	\$1495.00
END-000437 A & T w/2 SA-851Rs	\$1695.00

QUME DT-8

8" Double-Sided, Double-Density Disk Drive

1 Drive ...	\$524.95 each
2 Drives	\$499.95 each
10 Drives	\$479.95 each

Jade Part Number MSF-750080

Shugart 801R

8" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$394.95 each
2 Drives	\$389.95 each

Jade Part Number MSF-10801R

SIEMENS 8"

8" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$384.95 each
2 Drives	\$349.95 each
10 Drives	\$324.95 each

Jade Part Number MSF-201120

MPI B-51

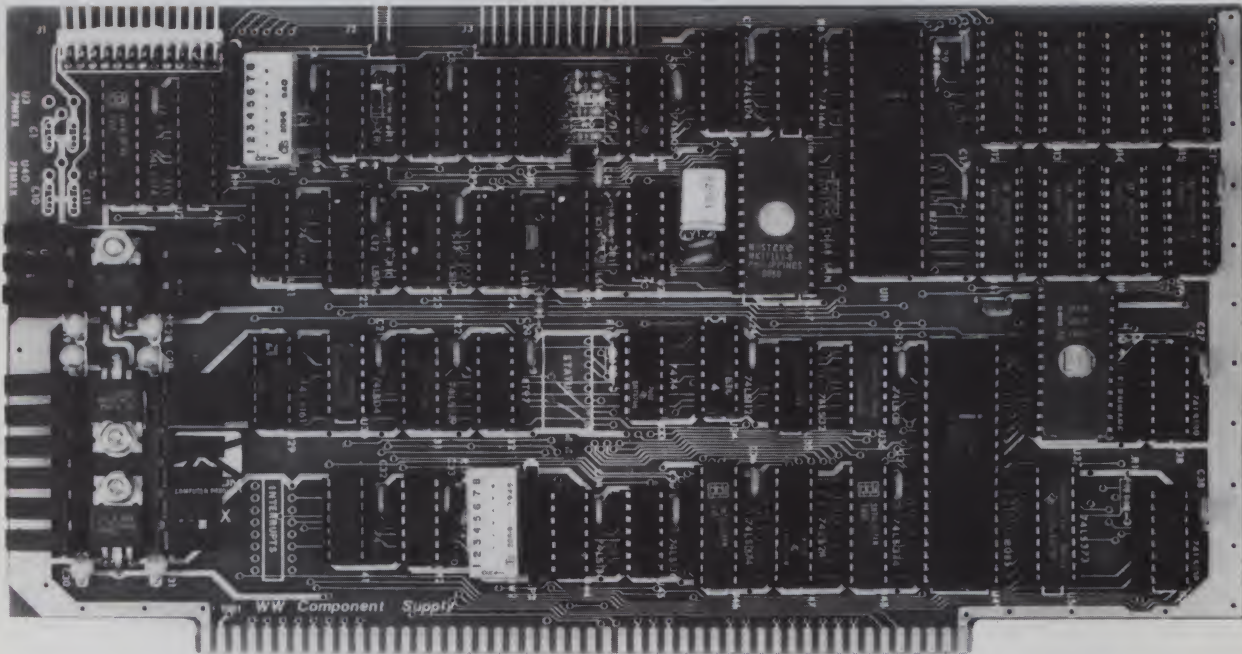
5 1/4" Single-Sided, Double-Density Disk Drive

1 Drive ...	\$234.95 each
2 Drives	\$224.95 each
10 Drives	\$219.95 each

Jade Part Number MSM-155100

END-000213 Case & power supply	\$74.95
--------------------------------	---------

INTELLIGENT VIDEO I/O FOR S-100 BUS



VIO-X

The VIO-X Video I/O Interface for the S-100 bus provides features equal to most intelligent terminals both efficiently and economically. It allows the use of standard keyboards and CRT monitors in conjunction with existing hardware and software. It will operate with no additional overhead in S-100 systems regardless of processor or system speed.

Through the use of the Intel 8275 CRT controller with an onboard 8085 processor and 4k memory, the VIO-X interface operates independently of the host system and communicates via two ports, thus eliminating the need for host memory space. The screen display rate is effectively 80,000 baud.

The VIO-X1 provides an 80 character by 25 line format (24 lines plus status line) using a 5 × 7 character set in a 7 × 10 dot matrix to display the full upper and lower case ASCII alphanumeric 96 printable character set (including true descenders) with 32 special characters for escape and control characters. An optional 2732 character generator is available which allows an alternate 7 × 10 contiguous graphics character set.



Distributed by

WW COMPONENT SUPPLY INC. 1771 JUNCTION AVENUE • SAN JOSE, CA 95112 • (408) 295-7171

The VIO-X2 also offers an 80 character by 25 line format but uses a 7 × 7 character set in a 9 × 10 dot matrix allowing high-resolution characters to be used. This model also includes expanded firmware for block mode editing and light pen location. Contiguous graphics characters are not supported.

Both models support a full set of control characters and escape sequences, including controls for video attributes, cursor location and positioning, cursor toggle, and scroll speed. An onboard Real Time Clock (RTC) is displayed in the status line and may be read or set from the host system. A checksum test is performed on power-up on the firmware EPROM.

Video attributes provided by the 8275 in the VIO-X include:

- FLASH CHARACTER
- INVERSE CHARACTER
- UNDERLINE CHARACTER or
- ALT. CHARACTER SET
- DIM CHARACTER

The above functions may be toggled together or separately.

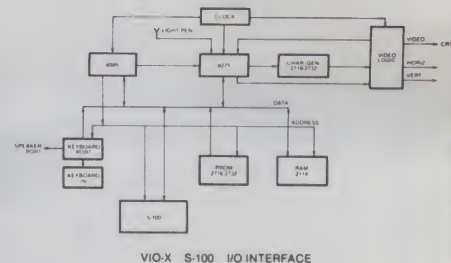
The board may be addressed at any port pair in the IEEE 696 (S-100) host system. Status and data ports may be swapped if necessary. Inputs are provided for parallel keyboard and for light pen as well as an output for audio signalling. The interrupt structure is completely compatible with Digital Research's MP/M ®.

Additional features include:

- HIGH SPEED OPERATION
- PORT MAPPED IEEE S-100 INTERFACE
- FORWARD/REVERSE SCROLL or
- PROTECTED SCREEN FIELDS
- CONVERSATIONAL or BLOCK MODE (opt)
- INTERRUPT OPERATION
- CUSTOM CHARACTER SET
- CONTROL CHARACTERS
- ESCAPE CHARACTER COMMANDS
- INTELLIGENT TERMINAL EMULATION
- TWO PAGE SCREEN MEMORY

VIO-X1 - 80 × 25 5 × 7 A & T **\$295.00**
Conversational Mode

VIO-X2 - 80 × 25 7 × 7 A & T **\$345.00**
Conversational & Block Modes



VIO-X S-100 I/O INTERFACE

DIGITAL RESEARCH COMPUTERS

(214) 271-3538

32K S-100 EPROM CARD NEW!



\$79.95
KIT

USES 2716's
Blank PC Board - \$34
ASSEMBLED & TESTED
ADD \$30

SPECIAL: 2716 EPROM's (450 NS) Are \$9.95 Ea. With Above Kit.

KIT FEATURES:

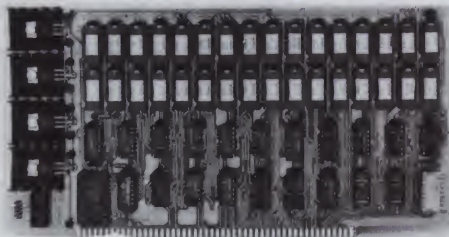
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

\$169⁹⁵
KIT

FOR 4MHZ
ADD \$10



KIT FEATURES:

1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-\$33
LOW PROFILE SOCKET SET-\$12
SUPPORT IC'S & CAPS-\$19.95
ASSEMBLED & TESTED-ADD \$35

**OUR #1 SELLING
RAM BOARD!**

NEW! STEREO! S-100 SOUND COMPUTER BOARD NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES:

- * TWO GI SOUND COMPUTER IC'S.
 - * FOUR PARALLEL I/O PORTS ON BOARD.
 - * USES ON BOARD AUDIO AMPS OR YOUR STEREO.
 - * ON BOARD PROTO TYPING AREA.
 - * ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
 - * PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
 - * EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
 - * USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.
- Both Basic and Assembly Language Programming examples are included.

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M™ compatible diskette or 2708 or 2716. Diskette - \$24.95 2708 - \$19.95 2716 - \$29.95. Diskette includes the source. EPROM'S are ORG at E000H. (Diskette is 8 Inch Soft Seccored)

4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! PRIME NEW UNITS!

8 FOR \$16 32 FOR \$59.95

Digital Research Computers
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32K SS-50 RAM

\$299⁰⁰ KIT

For 2MHZ
Add \$10

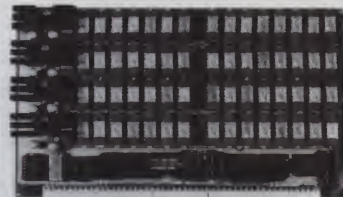
Blank PC Board
\$50

For SWTPC
6800 - 6809 Buss

Support IC's
and Caps
\$19.95

Complete Socket Set
\$21.00

Fully Assembled,
Tested, Burned In
Add \$30



At Last! An affordable 32K Static RAM with full 6809 Capability.

FEATURES:

1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

16K STATIC RAM SS-50 BUSS

PRICE CUT!

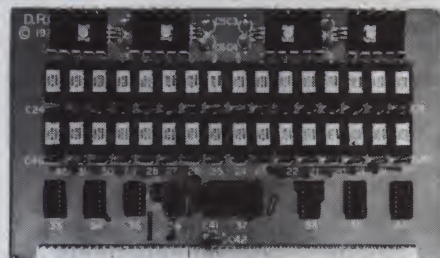
\$159 KIT

FULLY STATIC!

FOR 2MHZ
ADD \$10

FOR SWTPC
6800 BUSS!

ASSEMBLED AND
TESTED - \$35



KIT FEATURES:

1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD-\$35 COMPLETE SOCKET SET-\$12
SUPPORT IC'S AND CAPS-\$19.95

SPECIAL PURCHASE!

UART SALE!

TR1602B - SAME AS TMS6011,
AY5-1013, ETC. 40 PIN DIP

TR1602B

\$295 EACH

4 For \$10⁰⁰

CRT CONTROLLER CHIP

SMC #CRT 5037. PROGRAMMABLE FOR 80 x 24, ETC. VERY RARE
SURPLUS FIND. WITH PIN OUT. \$12.95 EACH.

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels. Noise Generator. 3 Channels of Amplitude Control. 16 bit Envelope Period Control. 2-8 Bit Parallel I/O. 3 D to A Converters. plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. **\$11.95** PRICE CUT!

SPECIAL OFFER: ~~\$14.95~~ each Add \$3 for 60 page Data Manual.

TERMS: Add \$2.00 postage. We pay balance. Orders under \$15 add 75¢ handling. No C.O.D. We accept Visa and MasterCard. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50, add 85¢ for insurance.

ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

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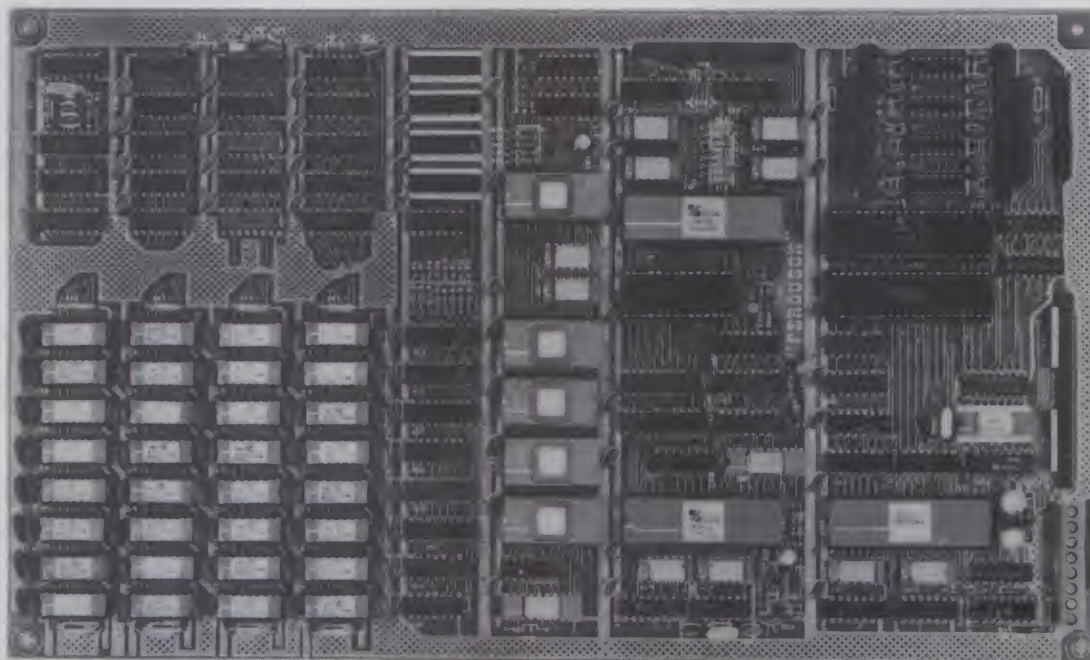
WE ARE NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

NEW!

"THE BIG BOARD" OEM - INDUSTRIAL - BUSINESS - SCIENTIFIC SINGLE BOARD COMPUTER KIT! Z-80 CPU! 64K RAM!

NEW!

PARTIALLY ASSEMBLED KITS
For All Sockets Installed
And Soldered Add \$50.



THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

\$649⁰⁰ **

(64K KIT
BASIC I/O)

SIZE: 8 1/2 x 13 1/4 IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERRUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: \$85.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

FLOPPY DISC CONTROLLER

Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: \$29.95

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: \$14.95

SYSTEM COMPARISON

64K RAM KIT	\$370.00
80 x 24 Video Kit	365.00
Floppy Disk Controller Kit	235.00
Z-80 CPU Kit	185.95
SER & PAR. I/O	129.95
S-100 Mother Board	45.00
SUB TOTAL	\$1330.90

Talk about bangs per buck! The prices shown for S100 kits were taken from the July 1980 BYTE. This will give some basis for comparison between the Big Board and a similar system Implementation on the S100 Buss.

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. modified by MICRONIX SYSTEMS to run on Big Board is available for \$150.00.

PC BOARD

Blank PC Board with Rom Set and Full Documentation.
\$199.00

PFM 3.0 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided. Z-80 is a Trademark of Zilog.

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TERMS: Shipments will be made approximately 3 to 6 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a \$75 deposit. Balance UPS COD. Add \$3.00 shipping.

USA AND CANADA ONLY

*TRADEMARK OF DIGITAL RESEARCH. NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA. THE ORIGINATORS OF CPM SOFTWARE
**1 TO 4 PIECE DOMESTIC USA PRICE.

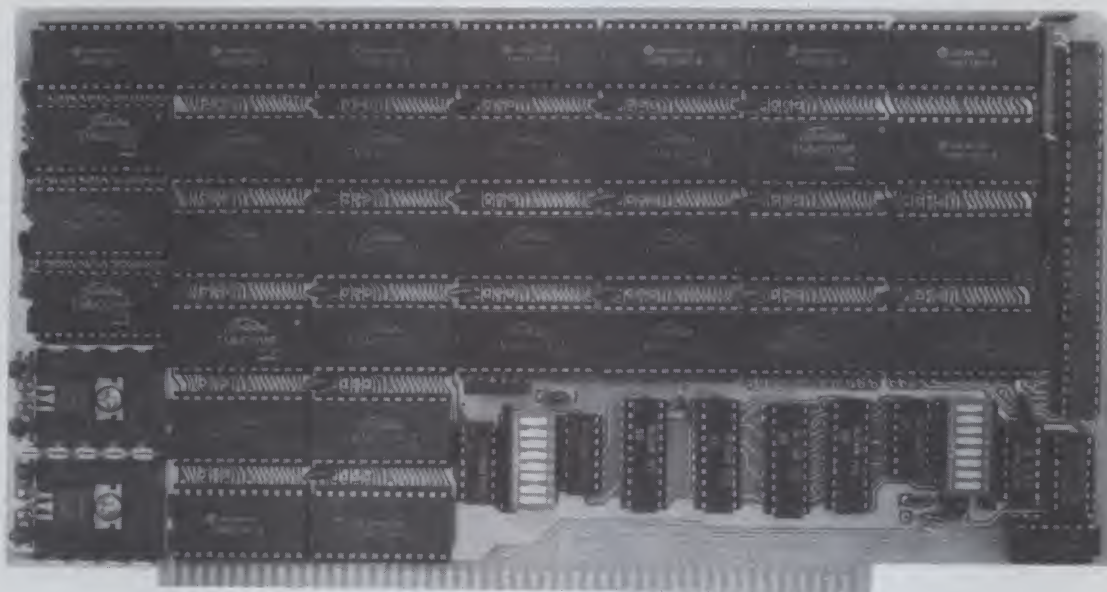
64K S100 STATIC RAM

NEW!

\$499⁰⁰
KIT

NEW!

LOW
POWER!



RAM
OR
EPROM!

BLANK PC BOARD
WITH DOCUMENTATION
\$55

SUPPORT ICs + CAPS - \$17.50
FULL SOCKET SET - \$14.50

ASSEMBLED AND TESTED ADD \$40

FEATURES:

- ★ Uses new 2K x 8 (TMM 2016 or HM 6116) RAMs.
- ★ Fully supports IEEE 696 24 BIT Extended Addressing.
- ★ 64K draws only approximately 500 MA.
- ★ 200 NS RAMs are standard. (TOSHIBA makes TMM 2016s as fast as 100 NS. FOR YOUR HIGH SPEED APPLICATIONS.)
- ★ SUPPORTS PHANTOM (BOTH LOWER 32K AND ENTIRE BOARD).
- ★ 2716 EPROMs may be installed in any of top 48K.
- ★ Any of the top 8K (E000 H AND ABOVE) may be disabled to provide windows to eliminate any possible conflicts with your system monitor, disk controller, etc.
- ★ Perfect for small systems since BOTH RAM and EPROM may co-exist on the same board.
- ★ BOARD may be partially populated as 56K.

FULLY SUPPORTS THE NEW
IEEE 696 S100 STANDARD
(AS PROPOSED)

FOR 56K KIT
\$449

16K STATIC RAMS?

The new 2K x 8, 24 PIN, static RAMs are the next generation of high density, high speed, low power, RAMs. Pioneered by such companies as HITACHI and TOSHIBA, and soon to be second sourced by most major U.S. manufacturers, these ultra low power parts, feature 2716 compatible pin out. Thus fully interchangeable ROM/RAM boards are at last a reality, and you get BLINDING speed and LOW power thrown in for virtually nothing.

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TERMS: Add \$2.00 postage. We pay balance. Order under \$15 add 75¢ handling. No. C.O.D. We accept Visa and MasterCard Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. Orders over \$50. add 85¢ for insurance.

PRINTERS 10 DAY FREE RETURN

EPSON MX-80
Now in stock!

C-ITOH STARWRITER: LETTER QUALITY PRINTING FOR UNDER \$1900! This daisy wheel printer gives high quality at a low price. 25 cps. Parallel and serial interfaces available.

NEW INTEGRAL DATA'S 560 PRINTER! All the exciting features of the 400 series plus 14 1/2" paper capacity. 132 col. graphics printer.
IDS 445! Lower price and improved print head. Available with or without graphics.
IDS 460! Features include correspondence quality printing. High resolution graphics.

NEC SPINWRITER FROM THE FIRST NAME IN LETTER QUALITY PRINTERS! Spinwriter 7700 series. Compumart offers beautiful print quality with NEC Spinwriter Terminals. We carry all models from RO THRU KSR WITH NUMERIC KEY-PAD- 7710-7730. All versions give unsurpassed hard copy output!

CENTRONICS 739! The latest innovations from the industry leader, and quiet too!

Visit our giant
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1250 North Main Street
Ann Arbor, Michigan

MONITORS TERMINALS CONFIGURATION HELP

CLEARANCE ZENITH COLOR VIDEO MONITOR \$275.

SUPER SELLING TERMINALS FROM LEAR SIGLER! Call for quotes.

ADM-3A! Industry's favorite dumb terminal for some very smart reasons.
ADM-5! More features for less than you think!
IT IS HERE! It is the new Intermediate Terminal from Lear Siegler.

NEC COLOR MONITOR/RECEIVER HIGH RESOLUTION! Composite video using BNC connectors, 8-Pin connector for VCR/VTR video loop In/Out and television reception.

SANYO MONITORS AT LOW COMPUMART PRICES! Sanyo's new line of CRT data display monitors are designed for the display of alphanumeric or graphic data.

9" SANYO B/W	\$169.
12" SANYO B/W	\$289.
12" SANYO W/	
GREEN SCREEN	\$299.
13" SANYO COLOR	\$495.

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MICRO

The most complete catalog of micro-computers, accessories and peripherals.

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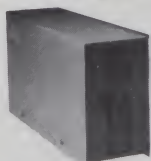
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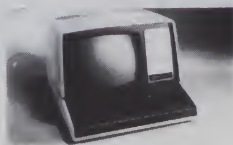
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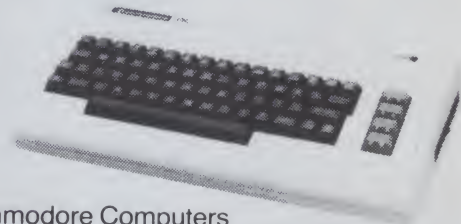
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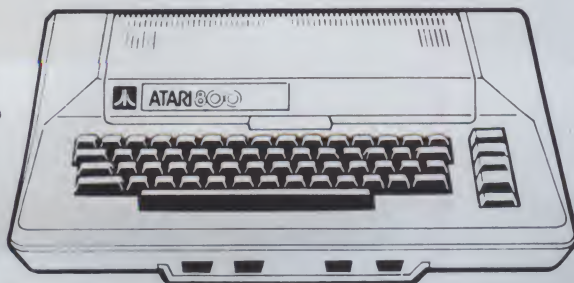
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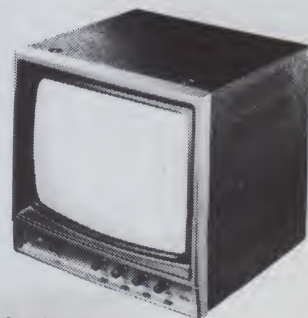
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Reader Service Number	Page	Reader Service Number	Page	Reader Service Number	Page
273	ABM Products.....126	279	IDPC Co.....149	*	Netronics R & D Ltd.....45, 108, 199
91	Aardvark Technical Services.....193	242	I/O Systems Inc.....106	286	NIBBLE Magazine.....189
466	Abacus Software.....194	223	The Information Center.....186	487	North Star Computers, Inc.....188
314	A Bargain Distributors.....30	Instant Software		53	Okidata Corp.....147
171	Addmaster Corp.....149	401	Memo.....89	130	Olenky Brothers, Inc.....54
334	Advanced Operating Systems.....70	402	Easy Calc.....90	89	Omega Sales Co.....57
39	Advanced Systems Concepts.....149	403	Master Reversi.....91	140	Omnitek Systems.....69
220	Adventure International.....105	404	Super Terminal.....92	29	Optimal Technology, Inc.....109
311	Alpha Byte Stores, Inc.....CII	405	Gypsy.....94	21	Options-80.....144
56	American Square Computers.....12, 13	405	Dealer List.....95	329	Orion Software.....8
187	Ancie Labs.....17	75	Programmers Kit.....70, 144, 198	464	PCD Systems, Inc.....194
319	Armadillo Computer Commuter.....23	77	Integrand Research Corp.....48	172	Pacific Exchanges.....8, 70, 116, 198
193	Aurora Software.....61	151	Interface, Inc.....66	153	Pacific Office Systems.....191
96	Automated Equipment, Inc.....51, 75	3	Intertec Data Systems.....3	*	Percom Data Company, Inc.....CII
485	Axiom Corp.....186	203	J.C. Datatron.....49	266	Perry Oil & Gas.....100
*	B.G. Micro.....166	180	J.E.S. Graphics.....51	303	Personal Computer Systems.....151
124	B.T. Enterprises.....48	353	JMC Corp.....52	106	Philadelphia Consulting Group.....55
488	Barreto and Associates, Inc.....186	92	J.P.C. Products.....42	146	Pocket Computer Newsletter.....78
326	The Bourbon Street Press.....187	126	JR Inventory Co.....204	*	Probability Software.....125
79	C & S Electronics Mart Ltd.....88	48	Jade Computer Products.....167, 168, 169	202	Progressive Computing.....55
148	CDR Systems, Inc. (Control Data Record).....144	41	Jameco Electronics.....158, 159	492	Project Planning Centre.....186
256	CPU Shop.....176	* John Bell Engineering.....117		44	Quest Electronics.....162
259	C.S.D.S. Inc.....70	499	KF Industries, Inc.....190	52	RNB Enterprises.....165
495	Cambridge Development Laboratory.....191	289	KV-33 Corp.....192	390	R.W. Electronics.....124
398	Card Electronics.....70	222	Kalglo.....50	101	Racet Computers Ltd.....190
469	China Institute in America, Inc.....194	475	Kate's Computers.....195	465	Rainbow Computing.....194
170	Chips & Dale.....36	54	Key Software.....191	102	Rand's Inc.....134
376	Communications Electronics.....160	Kilobaud Microcomputing		*	Realty Software.....200
90	CompuCover.....37	*	Subscriptions.....83	142	Riverbank Software.....192
*	Compumart.....174, 175	*	Desktop Computing.....127	74	Rondure Company.....200
147	Compuserve.....123	*	University Microfilms.....70	67	SGL Waber Electric.....16
320	Computer Case Company.....51	*	Dealers.....206	111	S.Z. Software Systems.....56
18	Computer Design Labs.....71	*	Books.....99, 155, 156, 157	146	Scelbi Publications.....78
120	Computer Discount of America.....64	*	Boxes, Binders.....197	483	Sinclair Research Ltd.....184
384	Computer Mail Order.....43	*	Encyclopedia.....130, 131	132	Sixty Eight Micro Journal.....88
331	Computer Marketing Services, Inc.....84	*	Back Issues.....70	*	Snappware, Inc.....201
110	Computers, Peripherals Unlimited.....42	*	Moving.....206	302	Software Connection.....134
362	Computer Plus.....140	198	LNW Research.....121	213	Software Consultants.....200
298	The Computer Shoppe.....144	355	Leading Edge Products.....CIV	357	Software Toolworks.....70
36	Computer Shopper.....85	477	Level 10 Division.....196	229	Speedway Electronics.....187
227	Computers Wholesale.....39	373	Logical Devices, Inc.....76	194	Standard Software Corp. of America.....55
6	Computronics.....111	491	Lynx Design & Technology, Inc.....188	143	Standard Software Corp. of America.....76
297	Concord Computer Products.....163	234	Magnolia Microsystems.....116	306	Standard Software Corp. of America.....187
58	Coosol, Inc./LRC400.....46	486	Mako Data Products.....184	217	Standard Software Corp. of America.....188
292	Coosol, Inc.....46	218	Mason Electronics.....52	479	Starside Engineering.....196
346	Corsair Computer Corp.....56	72	Master Electronics, Inc.....109	179	Stellation Two.....109
*	Cybernetics, Inc.....196	496	Maxi-Switch Co.....191	358	Stoneware Inc.....63
293	D & N Micro Products.....74	468	Media Service Concepts.....194	66	Strawberry Tree Computers.....23
145	DG Electronic Development.....67	165	Med Systems.....193	489	Strawberry Tree Computers.....192
113	Data Resource Corp.....195	161	Meta Technologies Corp.....7	244	Sun Research.....27
63	Davis Systems, Inc.....23	260	The Microcomputer Warehouse.....34	189	TAB Sales.....50
472	Dickens Data Systems.....195	248	MicrOdome.....78	350	Tatum Labs.....66
155	Digatek Corp.....70	308	Micro 80 Inc.....53	95	Technical Software Systems.....41
*	Digital Research Computers.....171, 172, 173	*	Micro Ink, Inc.....139	328	Texas Computer Systems.....54
*	Digital Research Parts.....166	100	Micro Management Systems.....150	478	Time Management Software.....196
250	Discount Software Group.....138	134	Micro Matrix.....56	150	Traxx Computer Corp.....15
482	Doss Enameling Company.....184	347	Micro Mint, Inc.....22	476	U.S. Software.....196
34	Dr. Daley's Software.....40	480	Micro-Sparc.....197	*	VR Data.....135
345	Eclectic Systems.....202	467	Micro-Tax, Microcomputer Taxsystems, Inc.....194	214	Van Horn Office Supply.....44
82	Ecosoft.....35	154	Micro Technology Unlimited.....143	490	Vector Graphic, Inc.....190
169	Elcomp Publishing Inc.....38	144	Midwest Scientific Instruments.....18, 19	474	Versa Computing, Inc.....195
95	Electronics Center.....177	*	Mikos/Wameco.....161	*	Voice-Tek.....31
23	Electronic Specialists.....35	255	Miller Microcomputer Services.....107	285	W.W. Components Supply.....170
272	Ellis Computing.....74	50	Mini Micro Mart.....207	*	Wameco/Mikos, Inc.....161
191	Floppy Disk Services.....77	226	Mini Micro Mart.....208	45	Westland Electronics.....198
471	Frank Hogg Laboratory.....195	238	Mini Micro Mart.....209	*	West Side Electronics.....49
22	GIMIX, Inc.....185	391	Minis & Micros Inc.....88	163	Wintek Corp.....8
351	Gryphon Micro Products.....134	37	Mullen Computer Products.....197	470	WITS, World Information and Technology Systems Corp.....195
*	Hanley Engineering.....101	81	Multi Bus Computer Systems.....44	122	World Wide Electronics, Inc.....116
243	Happy Hands.....53	497	MuSys Corp.....191	493	Young People's Logo Association.....186
484	Hayes Microcomputer Products, Inc.....186	186	N.F. Systems.....137		
498	Heath Company.....190	*	NRI Schools.....47		

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 - 3 \$3001-\$4000
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- C. What will be your next major Hardware purchase?**
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 - 2 Modem
 - 3 Disk System
 - 4 Other _____
- D. On average, how many of each issue's program listings do you actually type into your micro?**
- 1 0-2
 - 2 3-5
 - 3 6-8
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- E. How much have you spent on software?**
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- F. How do you acquire your software?**
- 1 I program it myself
 - 2 From magazines
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5	10	15	20	25	130	135	140	145	150	255	260	265	270	275	380	385	390	395	400
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51	56	61	66	71	176	181	186	191	196	301	306	311	316	321	426	431	436	441	446
52	57	62	67	72	177	182	187	192	197	302	307	312	317	322	427	432	437	442	447
53	58	63	68	73	178	183	188	193	198	303	308	313	318	323	428	433	438	443	448
54	59	64	69	74	179	184	189	194	199	304	309	314	319	324	429	434	439	444	449
55	60	65	70	75	180	185	190	195	200	305	310	315	320	325	430	435	440	445	450
76	81	86	91	96	201	206	211	216	221	326	331	336	341	346	451	456	461	466	471
77	82	87	92	97	202	207	212	217	222	327	332	337	342	347	452	457	462	467	472
78	83	88	93	98	203	208	213	218	223	328	333	338	343	348	453	458	463	468	473
79	84	89	94	99	204	209	214	219	224	329	334	339	344	349	454	459	464	469	474
80	85	90	95	100	205	210	215	220	225	330	335	340	345	350	455	460	465	470	475
101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
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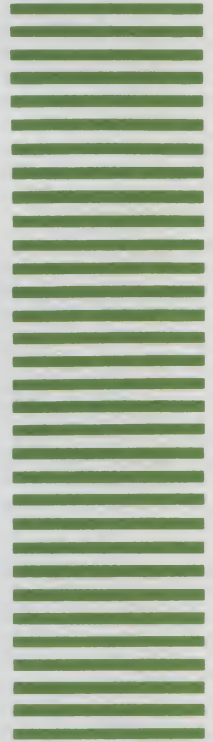
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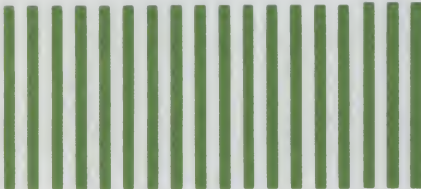
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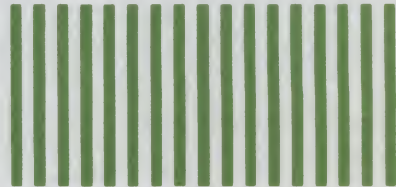
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LETTERS TO THE EDITOR

NTS Molasses

I found J.C. Hassall's article in the Oct. 1981 issue of *Microcomputing* ("Become a Troubleshooter—In 34 Easy Lessons," p. 182) most interesting, and, in a sense, comforting because I am also caught in the grip of the National Technical Schools molasses-like administration. My experience so far with NTS seems to be no better, and in one respect worse, than Mr. Hassall's. (I am enrolled for VA educational assistance reimbursement—the GI Bill—and NTS seems unable to properly handle the few additional bits of paperwork required by the VA!)

There is one bit of confusion in Mr. Hassall's article. NTS actually has (at least they did when I enrolled in April 1981) three microcomputer courses which eventually result in the student getting a Heath HN-89A computer. Course No. 1 is the long course (28 months to complete) without advanced standing; the cost is \$2875 at the \$75/month payment rate, \$2632 at the \$100/month rate. Course No. 1B (with advanced standing) has an estimated completion time of 25 months and costs \$2576/\$2381 at the payment rates mentioned. Course No. 1D (with advanced standing) has an estimated completion time of 18 months and costs \$2278/\$2130 at the foregoing payment rates. The difference between 1D and 1B is partly that 1D gets only the HN-89A computer, while 1B also gets the NTS "Compu-Trainer" and a digital logic probe.

In my view, the NTS 1D course is worth the money—provided the student is prepared to be patient with the slowness and confusion of NTS administration, and is not expecting to depend on NTS advisors for special help. Frankly, they don't seem to know what they're doing, at least in respect to microcomputers. The NTS advertisements are still saying that the Heath All-In-One Computer can have up to 32K bytes of memory!

I am especially disturbed by the "examination" system used by NTS. As Mr. Hassall said, almost all of the questions are really quoted statements from the text. Often they are used completely out of context in that the quotation is from discussion of a specific example in the text, but its use in an examination implies a general applicability that is false. The examination technique using quotations forces the student only to scan the text for the key words, but requires him/her to actually understand or learn nothing.

So far, I have pointed out to NTS eight

outright errors in their grading of examination questions, or in the wording of questions that resulted in more than one correct answer. In one case, a question quoted an error in the text (which misstated the meaning of the letters ASCII) indicating to me that the staff preparing and reviewing the examination questions know little or nothing about their subject!

My conclusion is that it is entirely up to the student to get his money's worth of learning from the NTS microcomputer course. He cannot even rely on the examinations, which should normally be a major part of the educational process.

Elmer A. Goetsch
Three Lakes, WI

I have received mail every day since the October issue came out with the National Technical Schools review "Become a Troubleshooter—In 34 Easy Lessons," p. 182. Every writer experienced the same problems which I described. Most indicated that, while the treatment described in the article is inexcusable, there is solace in the knowledge that others have been given the treatment.

I sent a courtesy copy of the article to Mr. R. Hessler, the manager of student services, inviting his comments. Three months later he responded that my "... comments are being studied and we will use them in making adjustments to the microcomputer course." New students who wrote indicate that no improvements have resulted from the article, so apparently I failed in my attempt to improve the situation through the "power of the pen."

Therefore, I suggest all students who are having trouble to send a letter to the National Home Study Council, 1601 18th Street N.W., Washington, D.C. 20009. I understand that these people certify home study schools. Include in the letter as much substantiating documentation as possible. Angry diatribes with no corroboration will have little effect. A word to G.I. Bill students: send a letter to the VA with the same information, also. They may reconsider the school's certification.

Beyond that, all I can say to presently enrolled students is either make a lot of phone calls to Mr. Hessler, or expect to wait. Eventually the kits will arrive. Good luck.

J.C. Hassall
Blacksburg, VA

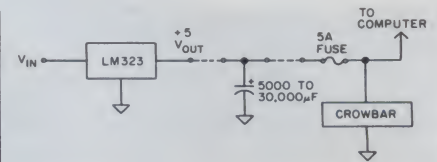


Fig. 1. Power supply modification.

Still Won't Burn

I have just read your reply to Ron Hasinger on p. 16 of the March 1981 issue. I wish to remind him that his 2 A fuse still won't burn.

He must be aware that a fuse rating at 2 A means it is specified to carry 2 A safely. The fusing current for a 2 A fuse is 4 A. Please note that fusing current is always double the rating current.

Further, the 2 A fuse he uses draws too much voltage and will upset his computer. (A 2 A fuse usually measures 0.2 or 0.3 ohms.) That's why OSI supplied him with a 5 A fuse.

To blow his 5 A fuse from a 3 A power supply, he must add a large value capacitor to the output point of his power supply as shown in Fig. 1. The extra capacitor will supply the current to blow the 5 A fuse when his crowbar works.

Charn-Leung Kong
Hong Kong

Lazy Writer Rave

I completely sympathize with the complaints in your October *Microcomputing* editorial: as a businessman I know what it's like trying to use a computer at a work station that wasn't designed for somebody who has more to do than enter data all day. But I think you're short-changing your system with the remark, "I find (a typewriter) better for most of my writing than the slower word processing systems."

I'm a fast typist, too. I used to write news for a TV station and I frequently write advertising copy for pocket money now. When I was in college I had a job as a secretary; at one time I was clocked at 65 words a minute. Most typewriters are too slow for my fingers.

About a year ago I purchased Lazy Writer, a word processing program by David Welsh, for my TRS-80 Model I. It's wonderful. Even though my machine has the old style (mechanical contact) keyboard, the processor keeps up with my fastest bursts of inspiration. Words wrap around the screen before I can say them in my head. Changes and revisions

are easy in the text entry mode, and almost automatic in the editing mode. In fact, the only software I've ever owned that I was this happy with was the stuff I wrote myself.

The publisher is also good about documentation (my Lazy Writer manual is almost half an inch thick) and terrific with support. When an upgrade was issued six months after I bought the program, they mailed me a copy—without my asking. When the package was returned by the post office as undeliverable, they sent it UPS. I suspect if UPS hadn't gotten through, they would have strapped it to a Saint Bernard.

In fact, the only problem I've had with the system (other than hardware problems; it's an old TRS-80) was with the upgrade. I like to use NEWDOS; the upgrade was released on TRSDOS, and I had some problems transferring one of the files. When I explained my problem to Therese Welsh (and sent her a few bucks to cover media and mailing), she mailed me a NEWDOS disk and a spare TRSDOS disk, just in case.

Lazy Writer offers straight and formatted disk saves, complete printer support, full editing, and even a module that'll process text in and out of an RS-232 board for communications. The publishers run their business as well as I try to run mine. If you're still convinced that you can write faster on your IBM, get a copy from them.

Jay Rose
Boston, MA

Plotting Data Revised

In the March 1980 issue of *Microcomputing* the article "Plotting Data or Functions" by Dr. Gordon W. Wolfe (page 167) contained a program for plotting a graph (in SWTP 8K BASIC) which we have revised and use almost every day in our engineering work.

The TRS-80 version that we use is shown in the Program listing. A sample problem printout is also shown.

This program combines Listings 1 and 3 from Dr. Wolfe's article as our work involves plotting X-Y coordinates rather than functions.

The only difference between Dr. Wolfe's original program and our version (other than changes in format due to the differences in BASIC) is that we have used -1, -1 as the flags to indicate the completion of coordinate entrances. This enables the plotting of (0,0), the origin of the X-Y coordinate axis, where desired (as in the sample problem).

The only difference between our TRS-80 version and an OSI MicroSoft BASIC version that we also use is that line 9870 (TAB(3)) in the TRS-80 version becomes TAB (5) in the OSI version.

Bernard L. Golding, PE
Orlando, FL

Program listing.

```

5 DIM T1(60,2)
10 T2=0
20 INPUT "X,Y COORDINATE";X,Y
30 T2=T2+1
31 T1(T2,1)=X
32 T1(T2,2)=Y
40 IF X<>-1 THEN 20
50 IF Y<>-1 THEN 20
51 T2=T2-1
55 PRINT:PRINT
56 FOR I=1 TO T2
60 PRINT T1(I,1),T1(I,2)
65 NEXT I
70 PRINT:PRINT
80 INPUT "X TITLE";X$
90 INPUT "Y TITLE";Y$
95 PRINT:PRINT
9520 PRINT TAB(10);Y$
9530 T3=9E-9:T5=T3
9540 T4=9E+9:T6=T4
9550 FOR I1=1 TO T2
9560 IF T1(I1,2)>T3 THEN T3=T1(I1,2)
9570 IF T1(I1,1)>T5 THEN T5=T1(I1,1)
9580 IF T1(I1,2)<T4 THEN T4=T1(I1,2)
9590 IF T1(I1,1)<T6 THEN T6=T1(I1,1)
9600 NEXT I1
9610 U5=INT(2.3*LOG(ABS(T3)))
9620 PRINT TAB(9);T4;TAB(56);T3
9630 PRINT TAB(10);
9640 FOR I1= 1 TO 53
9650 PRINT "-";
9660 NEXT I1
9665 PRINT
9685 U8=1
9690 T8=(T5-T6)/40
9700 T9=(T3-T4)/50
9710 FOR I1=1 TO 40
9720 U9=ASC(X$)
9730 IF U9=0 THEN U9=32
9740 X$=MID$(X$,2)
9741 IF X$="" THEN X$=" "
9745 U7=T6+(I1-1)*T8
9760 PRINT CHR$(U9);CHR$(32);
9762 PRINT USING"###.##";U7;
9763 PRINT CHR$(33);
9764 IF U8+1>T2 THEN 9766
9765 IF U7>T1(U8+1,1) THEN U8=U8+1
9766 IF I1=40 THEN 9780
9770 IF U7<T1(U8,1) THEN 9840
9780 U6=INT((T1(U8,2)-T4)/T9-.01)
9785 IF U6<=0 THEN 9820
9790 FOR I2=1 TO U6
9800 PRINT CHR$(32);
9810 NEXT I2
9820 PRINT CHR$(42)
9825 U8=U8+1
9830 GOTO 9860
9840 PRINT CHR$(32)
9860 NEXT I1
9870 PRINT TAB(3);T5
9880 END

```

Sample run.

```

X,Y COORDINATE? 0,0
X,Y COORDINATE? 10,40
X,Y COORDINATE? 20,100
X,Y COORDINATE? 30,80
X,Y COORDINATE? 40,60
X,Y COORDINATE? 50,40
X,Y COORDINATE? 60,20
X,Y COORDINATE? 70,10

```

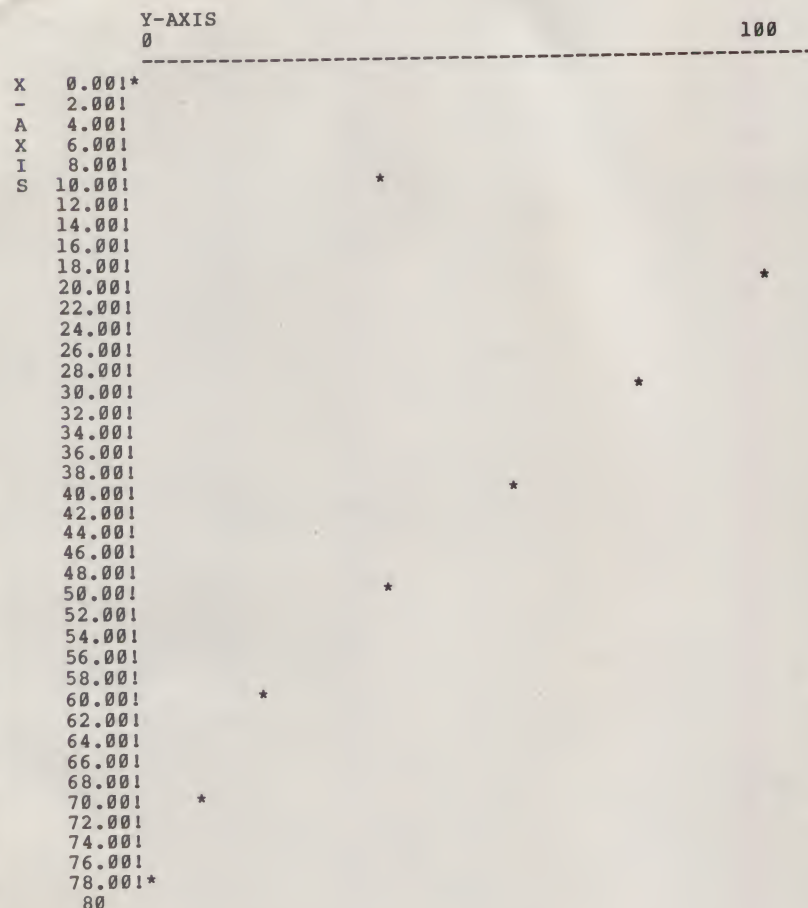
More →

Sample run continued.

X,Y COORDINATE? 80,0
X,Y COORDINATE? -1,-1

0	0
10	40
20	100
30	80
40	60
50	40
60	20
70	10
80	0

X TITLE? X-AXIS
Y TITLE? Y-AXIS



Dealer's Fault?

I was surprised to see the letter by Duncan Moyer in your November issue (p. 211). I too have bought an Osborne. The problem Mr. Moyer had (additional charge for setup) must have been just a problem he had with his local dealer. I bought mine through Computer Center in Rochester, NY. The dealer was helpful from the time I first inquired about the Osborne until the final delivery. The only extra costs I encountered were the New York state sales tax. There was no setup or any other extra charges. I have not had

the opportunity to test his warranty repair, as the machine has functioned perfectly since I have had it. The problem Mr. Moyer has is not with Osborne Computer Corp. but rather with a dealer attempting to make a few extra bucks.

William L. Roberts
Brooktondale, NY

Where to Turn?

My business uses a Cromemco Z2 computer and I have had three years of good

service with it. However, this summer a piece broke in the PerSci disk drive and I have been unable to get it fixed. I have written PerSci, Cromemco, an advertiser in the Cromemco User's Group Newsletter, as well as having a local dealer try to get the part for me.

Cromemco did answer my letter after about six weeks, but offered no help. PerSci has yet to be heard from. The advertiser answered promptly, but did not sell parts. The local dealer drew a blank with PerSci, also.

So I limp along with a single drive, not knowing where to turn. Cromemco is doing well, probably best of the S-100 companies, and I see that PerSci has a new prestigious ad out. But can they compete with IBM without spare parts support?

Malcolm Gillis, president
MEGA Corporation
Toney, AL

Literature Appreciation

After reading the review of Stan Kelly-Bootle's *The Devil's DP Dictionary* by John Edwards (*Microcomputing*, Oct. 1981, p. 260), it is my studied opinion that the review should have never been allowed to reach print. It is obvious that Mr. Edwards did not (or more likely was unable to) understand the context within which, and the viewpoint from which, the *Devil's DP Dictionary* was written.

One's earliest training in literature appreciation concerns the idea of reading the introduction or preamble (if one is provided). If Mr. Edwards had done this, he would have learned that the book was intended to be sort of an appendix of technical terms to Ambrose Bierce's *Devil's Dictionary*. Bierce's book expounds on words common to all human experience, therefore its humor is accessible to everyone. Kelly-Bootle's concerns itself with those terms in the common experience of the mainframe computer world not those in the world of the micro "baby boom." In both cases, the humor is witty and subtle. Not of the type that clubs one over the head as Mr. Edwards seems to require. If the reader is not intimately familiar with the words and phrases and their real meanings, much of the humor could fly right over their heads. It is easy to get some help from a knowledgeable friend as I did (and, apparently, as Mr. Edwards did not). About the only point on which I concur is that the price is a bit high. But the group to which the book is directed (long-time dp professionals) is still rather small compared to the prospective audience for a Harold Robbins novel. The economics of scale apply.

Welbrey A. Hill, Jr.
Tallahassee, FL

Beware the New Electronic Media

Intro for 6800 Experimenters

Stargazer's Guide to Computing

Electronic Nightmare: The New Communications And Freedom

John Wicklein
Viking Press, 1981
Hardcover, 282 pp., \$14.95

Is there life after high tech? John Wicklein thinks so—but as the title of this book indicates, he doesn't think it's going to be handed to us on a platter.

Wicklein, a former *New York Times* editor and once a programmer for several TV stations, foresees a wide range of problems arising from what he calls the "multifaceted, integrated communications system" offered by modern electronic communications.

"The new technologies of communication can provide great benefits to society—I have no doubt about that," he says. "But unless we plan carefully for their arrival, rather than let them hit us head-on, the threats they bring with them may outweigh the benefits we may enjoy."

In particular, Wicklein is afraid that electronic media will lead to serious abuses of our right to privacy. Corporations or the government could compile a highly detailed profile of anyone who uses videotext systems for home banking, shopping and information retrieval. Such a dossier could, for instance, tell any interested party whether you'd bought books that espoused unpopular political views. It could tell to what causes you had made contributions. It could provide details on who you associated with, what products you bought and what magazines you read. Two-way television—such as the Qube system in Columbus, OH—offers other possibilities. The central computer can, for instance, keep careful track of what you watch, or monitor the views you express during interactive programs.

But the potential problems don't end here. Consider, for example, the ease with which this information could be made available. No laws currently pre-

vent corporations from selling such dossiers to anyone with the money. Furthermore, it is a simple matter to tap communications lines without the knowledge of either the citizen or the host computers. And finally, a system could select from its database what Wicklein calls "guidance" items "to apply a corrective to the subscriber's mindset" if that subscriber is deemed to have objectionable political opinions.

Such a scenario seems, on the surface, to be absurd. But two prominent names in recent American history prove different—Joseph McCarthy and Richard Nixon. It was McCarthy who used seemingly innocent facts to persecute innocent citizens, and it was Richard Nixon who tried to systematically undermine our right to freedom of expression and belief through illegal wiretaps and surveillance.

Even Wicklein's proposal that information could be prescreened to correct a citizen's opinions doesn't seem so ridiculous when one considers the extent to which the Moral Majority and other conservative groups are trying to control what Americans see, hear and read. (Wicklein points to a case in which five dictionaries were pulled from the shelves of a Texas school because they contained too many objectionable words. What would the Moral Majority think about an electronic encyclopedia that included details about the human reproductive system?)

Privacy is not the only issue Wicklein tackles. He also discusses, for example, the question of who will provide and control information that will be transmitted to American homes. Does videotext fall within the regulative boundaries of the Federal Communications Commission? If so, will newspapers that transfer to new electronic media slowly lose their First Amendment right to freedom of the press? If a monolithic communications system develops in the hands of a megacorporation like AT&T, how can we be sure that the news will not be censored to support that corporation's self-serving vision of the world?

Also, who will have access to such a system? Will citizen's organizations and individuals be able to use it for a reasonable price? Will people with questionable political opinions be given a fair chance to use the medium?

Wicklein is committed to the idea that AT&T should not be allowed to operate as both a carrier and information-provider. He points to enormous problems in calling to account "the world's largest private corporation with an annual budget and revenues greater than most countries of the world."

Wicklein continues: "The temptation of such a powerful entity to influence, to interfere with, or subtly or openly to try to control the content of the nation's news and information lifeline over which it had been given exclusive jurisdiction would be very great indeed."

If Wicklein had stopped with these major questions, he would have had himself a substantial book. Unfortunately, he tries to cover a number of other issues: the impact of modern telecommunications on social relationships, whether governments and corporations will tend to centralize or decentralize, whether rich countries and multinational corporations will use information extracted from less-developed countries for national and commercial gain, and the impact of satellite technology. While Wicklein intended his book to be an overview of the potential dangers of electronic media, he tries to cover far too much. By the end of the book, the reader is following far too many threads of thought, and Wicklein fails to tie them up satisfactorily.

Nevertheless, *Electronic Nightmare* offers some important insights into the potential ramifications of the new electronic media. We would do well to remember Wicklein's concluding sentence:

"None of the potential benefits of the new communications will come about unless we shape the technology to human ends and not let it shape us in a commercial or authoritarian mold."

Eric Maloney
Microcomputing staff

Microcomputer Experimentation with the Motorola MEK 6800D2

Lance A. Leventhal
Prentice-Hall, Inc., 1981
Softcover, 438 pp.

Microcomputer Experimentation with the MEK 6800D2 is a good introductory text on microcomputers and also offers material for the more advanced student or hobbyist. The book is set up so that the reader can carry out the problems and examples on an MEK 6800D2 microcomputer, a 6800-based machine-language computer with a keyboard and seven-segment LED displays. This computer has a well-thought-out monitor program and doesn't require a CRT terminal, making it a good low-cost tool for individual or class study.

The text is clearly written and well organized. Each chapter covers a particular topic and introduces terms and 6800 instructions as required. Many of the examples and problems involve running programs on the MEK 6800D2 as is; others require a small amount of additional hardware such as LEDs, TTL ICs and switches. The hardware additions are minor in nature and are well documented so they should pose little problem, even for the novice. The author often presents both hardware and software approaches to the same problem and discusses the trade-offs in cost, development time and performance. The examples in the book which I ran on the computer were bug free, which supports the statement on the back cover that the examples are fully tested.

The first five chapters cover use of the MEK 6800D2 JBUG monitor commands as well as simple input and output using switches and LEDs. Switch debouncing as well as output to seven-segment displays are discussed using both hardware and software methods. Later chapters cover how to handle tables of data using 6800 machine or assembly language, flowcharting and debugging, the use of breakpoints and single stepping, and binary and BCD arithmetic. Chapters A-F treat slightly more advanced topics including subroutines and stack, I/O (using handshaking), interrupts, timing methods, serial I/O and microcomputer timing and control. Topics are covered clearly from the ground up with examples and problems to be carried out on the MEK 6800D2.

Of particular interest to me were discussions of the proper use of the stack, the JBUG monitor subroutines, subtleties of various instructions, changing of parameters on the stack using indexed addressing and the use of timing loops to determine the rate of incoming serial data. The chapter on serial I/O was particularly good because the examples used the on-board UART hooked up in a loop-

back mode allowing you to send and receive serial data and get a feel for the process.

This book is set up to teach microcomputer techniques by having the reader try the problems and examples on his own system. Although it doesn't include any full blown projects, you should be well prepared to use a microcomputer in your own application after you finish the book.

The only shortcoming I can find with the book is that its dedication to one microcomputer may discourage its use by other 6800 microcomputer users. I recommend it as a text for an introductory

structure from the start. Every function performed by Erlewine's programs, from planetary calculations to keyboard input, is contained in discrete subroutines. These routines may be chosen and combined by students to custom tailor their own programs with whatever features they desire.

While the features described above make this book useful to any beginning BASIC programmer, the manual is especially valuable to those who are interested in astrological, or even straight astronomical, calculations.

A few years ago I wanted to write a pro-

The manual is especially valuable
to those who are interested in astrological,
or even straight astronomical, calculations.

microcomputer lab course. Owners of other 6800-based systems will also find the book of interest if they plan to use it for reference only, or don't mind modifying the examples and problems to run on their particular machine.

Peter W. Marcus
Miami, FL

Manual of Computer Programming for Astrologers

Michael Erlewine
The American Federation of Astrologers
Tempe, AZ, 1981
Paperback, 218 pp., \$13.95

This book is valuable for two groups of people: astrology buffs and students of BASIC programming.

The opening sections deal with all the fundamentals one would expect to be covered in a good primer: direct versus programming (or deferred) modes, variables, arrays, operators, hierarchy of operations, error messages, editing, etc. Erlewine's treatment of these basic concepts is lucid and concise.

A valuable feature of the book is its reference section of BASIC keywords. This is like an extremely abridged edition of Lien's BASIC Handbook. It contains a rundown of the Microsoft keywords, and describes how different dialects accomplish similar functions. For example, both the TRS-80's INKEYS and the PET's and Apple's GET statements are covered. The information is also summarized in a BASIC language reference list.

Erlewine's section on compacting is one of the best treatments I've seen on the venerable art of squeezing that last byte of programming into your dwindling memory reserves.

After covering the basics, Erlewine goes on to deal with program planning and flow. One of the advantages of his approach is that the student learns modular

program to draw astrological charts. My search for the algorithms for calculating planetary motions proved frustrating. Before dropping the project, I checked city and college libraries. I also made a trip to NYC's Hayden Planetarium to use their special astronomical reference section. I could find no material to even help me get a handle on the raw mathematics involved, let alone predigested computer algorithms.

This book provides three different routines and databases for calculating planetary motions. The three methods differ in precision, memory-use, speed and date range. One accepts any dates from 4713 B. C. forward and is accurate to within one degree. Another may be used only for dates between A.D. 1900 and A.D. 2000, but is accurate to within several minutes of arc, is quite fast and easily fits into 8K. The third is accurate to within one minute of arc. Routines are also given for the moon and its nodes, asteroids and the Uranian planets.

Some of the other topics covered are progressions, returns, relocations, aspects, midpoints and sorts. House systems supported are Regiomontanus, Porphyry, Equal, Morinus, Koch, Topocentric, Campanus and Placidus. Attention is given to formatting the output and representing a chart on a video monitor.

One warning note: The book states that all its routines are copyrighted and that while they may be freely used by the student in his own programs, they must not be sold. So if you are planning to use this book to create your own commercial astrological software, be prepared to comprehend the ideas involved and write your own programs from the algorithms up.

The Manual of Computer programming may be purchased for \$13.95 from Matrix Software, 315 Marion Ave., Big Rapids, MI 49307.

Paul Weiner

Get It Together with Apple Sound Synthesis for Heath New Sinclair, North Star Micros

Apple Organizer

The Apple-Center from Doss Enameling Company, 1224 Mariposa St., San Francisco, CA 94107, was designed to house an Apple computer, a 9-inch monitor and two disk drives. The circuitry protects your Apple from voltage surges, and a cooling fan prevents overheating. A key-locking on/off switch prevents unwanted use. The monitor is angled for comfortable viewing, and the organizer's flat top provides a handy place for an extra monitor or a printer. The price will be approx. \$300. Reader Service number 482.

Heath/Zenith Sound Effects

Create sound effects for games or play music from your keyboard. Multiple programmable sound generators using the General Instruments AY3-8910 psg chip are available for Heath/Zenith computers. This chip can produce a wide variety of complex sounds under software control. The psgx2 for the Z/H-89 has two psg chips, plugs into P504 or P505 of the H-89 bus and uses any decoded port address. The psgx4 contains four of these chips and plugs directly into the H8 bus. Each board comes with a

speaker and features a built-in audio monitor amplifier and crystal time base. Multiple chips give multiple complex sounds, and each chip offers two eight-bit parallel I/O ports, which have been pinned out on the board. The psgx2 costs \$125 and the psgx4 costs \$225, plus \$5 for shipping and handling.

Mako Data Products, 1441-B N. Red Gum, Anaheim, CA 92806. Reader Service number 486.

Portable Computer From Sinclair

Sinclair Research Ltd., 2 Sinclair Plaza, Nashua, NH

03061, has introduced the ZX81 microcomputer. The Sinclair ZX81 is based upon an innovative four-chip design, and it measures just 6 x 6.5 x 1.5 inches and weighs 12 ounces. It has an 8K-byte BASIC ROM, enabling it to operate in decimal arithmetic with full scientific functions. A 40-key touch-sensitive membrane keyboard gives the equivalent of 91 keys using function mode and single-press keyword system. Graphics mode enables an additional 20 graphical and 54 inverse video characters. Programs can be loaded and saved on any home cassette player. A 16K RAM attaches to the



The Apple-Center from Doss Enameling Company.



The Sinclair ZX81 microcomputer.



JUDGE THE REST, THEN BUY THE BEST

Only GIMIX offers you **SOFTWARE SWITCHING** between **MICROWARE's OS-9** and **TSC's FLEX**. Plus you get the power of the **GMXBUG** system monitor with its advanced debugging utility, and memory manipulation routines. A wide variety of languages and other software is available for these two predominant 6809 Disk Operating Systems.

You can order a system to meet your needs, or select from the 6809 Systems featured below.

JUDGE THE FEATURES AND QUALITY OF GIMIX 6809 SYSTEMS

GIMIX' **CLASSY CHASSIS™** is a heavyweight aluminum mainframe cabinet with back panel cutouts to conveniently connect your terminals, printers, drives, monitors, etc. A 3 position keyswitch lets you lock out the reset switch. The power supply features a ferro-resonant constant voltage transformer that supplies 8V at 30 amps, + 15V at 5 amps, and - 15V at 5 amps to insure against problems caused by adverse power input conditions. It supplies power for all the boards in a fully loaded system plus two 5 1/4" drives (yes! even a Winchester) that can be installed in the cabinet. The Mother board has fifteen 50 pin and eight 30 pin slots to give you the most room for expansion of any SS50 system available. 11 standard baud rates from 75 to 38.4K are provided and the I/O section has its own extended addressing to permit the maximum memory address space to be used. The 2 Mhz 6809 CPU card has both a time of day clock with battery back-up and a 6840 programmable timer. It also contains 1K RAM, 4 PROM/ROM/RAM sockets, and provides for an optional 9511A or 9512 Arithmetic Processor. The RAM boards use high speed, low power STATIC memory that is fully compatible with any DMA technique. STATIC RAM requires no refresh timing, no wait states or clock stretching, and allows fast, reliable operation. The system includes a 2 port RS232 serial interface and cables. All GIMIX boards use gold plated bus connectors and are fully socketed. GIMIX designs, manufactures, and tests in-house its complete line of products. All boards are twice tested, and burned in electrically to insure reliability and freedom from infant mortality of component parts. All systems are assembled and then retested as a system after being configured to your specific order.

56KB 2MHZ 6809 SYSTEMS WITH GMXBUG/FLEX/OS-9 SOFTWARE SELECTABLE

With #58 single density disk controller **\$2988.59**
 With #68 DMA double density disk controller **\$3248.49**
 to substitute Non-volatile CMOS RAM with battery back-up, add 300.00
 for 50 Hz export power supply models, add 30.00

Either controller can be used with any combination of 5" and/or 8" drives, up to 4 drives total, have data recovery circuits (data separators), and are designed to fully meet the timing requirements of the controller I.C.s.

5 1/4" DRIVES INSTALLED IN THE ABOVE with all necessary cables

	SINGLE DENSITY		DOUBLE DENSITY		
	Formatted	Unformatted	Formatted	Unformatted	
40 track (48TPI) single sided	199,680	250,000	341,424	500,000	2 for \$700.00
40 track (48TPI) double sided	399,360	500,000	718,848	1,000,000	2 for \$900.00
80 track (96TPI) single	404,480	500,000	728,064	1,000,000	2 for \$900.00
80 track (96TPI) double	808,960	1,000,000	1,456,128	2,000,000	2 for \$1300.00

Chart shows total capacity in Bytes for 2 drives.

Contact GIMIX for price and availability of 8" floppy disk drives and cabinets; and 5" and 8" Winchester hard disk system.

128KB 2Mhz 6809 DMA Systems for use with TSC's UNIFLEX or MICROWARE's OS-9 Level 2

(Software and drives not included) **\$3798.39**
 to substitute 128KB CMOS RAM with battery back-up, add 600.00
 for each additional 64KB NMOS STATIC RAM board, add 639.67
 for each additional 64KB CMOS STATIC RAM board, add 988.64
 for 50 Hz export power supply, add 30.00

NOTE: UNIFLEX can not be used with 5" minifloppy drives.

GIMIX has a wide variety of RAM, ROM, Serial and Parallel I/O, Video, Graphics, and other SS50 bus cards that can be added now or in the future. Phone or write for more complete information and brochure.

THE SUN NEVER SETS ON GIMIX USERS

GIMIX Systems are found on every continent, except Antarctica. (Any users there? If so, please contact GIMIX so we can change this.) A representative group of GIMIX users includes: **Government Research and Scientific Organizations** in Australia, Canada, U.K., and in the U.S.; NASA, Oak Ridge, White Plains, Fermilab, Argonne, Scripps, Sloan Kettering, Los Alamos National Labs, AURA. **Universities:** Carleton, Waterloo, Royal Military College, in Canada; Trier in Germany; and in the U.S.; Stanford, SUNY, Harvard, UCSD, Mississippi, Georgia Tech. **Industrial users** in Hong Kong, Malaysia, South Africa, Germany, Sweden, and in the U.S.; GTE, Becton Dickinson, American Hoechst, Monsanto, Allied, Honeywell, Perkin Elmer, Johnson Controls, Associated Press, Aydin, Newkirk Electric, Revere Sugar, HI-G/AMS Controls, Chevron. **Computer mainframe and peripheral manufacturers,** IBM, OKI, Computer Peripherals Inc., Qume, Floating Point Systems. **Software houses;** Microware, T.S.C., Lucidata, Norpak, Talbot, Stylo Systems, AAA, HHH, Frank Hogg Labs, Epstein Associates, Softwest, Dynasoft, Research Resources U.K., Microworks, Analog Systems, Computerized Business Systems.



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back of the ZX81 to expand the size of the computer's memory. Assembled price is \$149.95; kit is \$99.95. Reader Service number 483.

It's About Time

Hayes Microcomputer Products, Inc., 5835 Peachtree Corners East, Norcross, GA 30092, has introduced the Hayes Stack Chronograph, an RS-232-compatible calendar/clock for microcomputers. The Chronograph quartz-crystal control adds precise timekeeping to computer sys-

tems. With the Chronograph and user-developed software, your computer can log programs and reports by day, date and time. The Chronograph can also provide information to control lights, burglar alarms and sprinkler systems. To cut the cost of electronic mail, the user can develop programs to batch messages during the day and send them at night when telephone rates are lowest. The system, including Chronograph unit, power pack, three AA batteries and owner's manual, costs \$249. Reader Service number 484.



The Hayes Stack Chronograph from Hayes Products, Inc.

Heath/Zenith SOURCEBOOK

A directory to Heath/Zenith compatible products, The Information Center Sourcebook features over 200 pages of abstracts and listings, including:

HARDWARE	SOFTWARE
PRINTED MATTER	USER'S GROUPS
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Three quarterly updates are mailed free to all owners of the Sourcebook.

The Information Center Sourcebook is available at Heathkit Electronic Centers* and computer stores nationwide, or for \$20.00 from:

The Information Center ✓ 223
642-A W. Rhapsody
San Antonio, Texas 78216
512/340-1561
Dealer inquiries invited.

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Axiom Corporation's Model EX-1650 printer.

Electronic Notepad

Axiom's Model EX-1650 printer produces full-sized hard copy directly from a video input device, such as a video computer terminal, graphics terminal, video monitor or TV set. Any displayed data, including complex graphics, alphanumeric data in any size or font, foreign symbols or even hieroglyphics can be quickly reproduced on electrosensitive paper. The printer operates from the composite video information displayed on the screen, and requires only a single connection to a standard video jack. No external hardware or software is required. Price is \$3495.

Axiom Corporation, 5932 San Fernando Road, Glendale, CA 91202.

Business Computing

The MicroMaster from Barreto and Associates, Inc., 507 West 16, Sedalia, MO 65301, is a self-contained desktop computer. It operates under a

modified CP/M, and is designed for use in small and intermediate businesses. The system is IEEE S-100 based, and contains both a 5¼-inch 5 megabyte Winchester drive and a floppy drive. Standard 64K-byte random access memory is expandable to 16 megabytes. The system can be configured for single or multiple users. The 12-inch monitor has an 80 character by 24 line format. The unit's multiprocessor architecture and special operating system speed operation. The MicroMaster sells for \$12,500. Reader Service number 488.

Publications of Note

A helpful publication on school use of microcomputers is available from the Project Planning Centre, Ministry of Education, Legislative Buildings, Victoria, BC V8V 1X4. The discussion paper, "Instructional Use of Microcomputers: A Report on BC's Pilot Project," is an 80-page document which outlines the results of an innovative test project in British Columbia's schools. Reader Service number 492.

The Turtle News is offered, free, to subscribers under 18 years of age. The monthly newsletter is published by the Young People's Logo Association, 1208 Hillsdale Drive, Richardson, TX 75081, to bring together young programmers using Logo and other languages. It will promote educational and recreational use of microcomputers.



The MicroMaster business microcomputer from Barreto and Associates.

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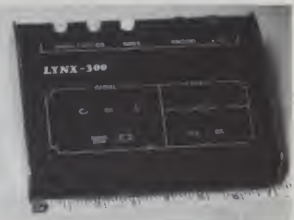
and provide a catalog for exchange of software written by YPLA members. The use of microcomputers in the education of the learning disabled and handicapped will also be encouraged by the exchange of information and software. Annual subscription price for parents, teachers and other grown-up people is \$15. Reader Service number 493.

Programmer, a new publication from Media21, offers programming and marketing tips to writers of microcomputer software. It provides information on contracts, agents and royalties, as well as specific help with programming techniques. *Programmer* gives the small, independent software producer a chance to express market needs, and fields as many questions from readers as possible. The newsletter is not currently accepting advertising. Subscription cost is \$13 for the first six issues.

Programmer, PO Box 3210, Manchester, NH 03105. Reader Service number 494.

Dual-Processor Micro

North Star's Advantage microcomputer uses two processors: the Z80A as the main CPU and an Intel 8035 as the keyboard and disk controller. The full system has 64K bytes of random-access memory with parity as the main memory, 20K of dedicated random-access memory for the display and a 2K bootstrap programable read-only memory for the display and floppy disks. The standard screen format is 24 lines by 80 characters, with a graphics resolution of 240 pixels high by 640 pixels wide.



The Lynx-300 disk alignment tool.

The Advantage is supported by one of three different operating systems: the Application Support Program (ASP), Graphics CP/M or North Star's Graphics BASIC/Graphics DOS. Priced under \$4000.

North Star Computers, Inc., 14440 Catalina St., San Leandro, CA 94577. Reader Service number 487.

Quick Alignment Tool

The Lynx-300 is a portable, compact and low-cost solution to the problem of verifying and adjusting the alignment of floppy-disk drives. This instrument lets technical support personnel make all the necessary adjustments without the need for an oscilloscope. Any technician can quickly and easily verify and adjust the alignment of any floppy drive encountered. The Lynx-300 uses a series of LEDs to indicate the proper setting for radial and index/sector adjustments. If the proper LED is not illuminated, the drive adjustment is not within specifications. The Lynx is powered by the disk drive being adjusted. It comes with a set of color-coded probes that are attached simultaneously to the drive PCB, reducing the possibility of error in hookup and speed-



North Star's Advantage offers sophisticated microcomputer graphics.

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
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ing the alignment process. The Lynx-300 comes in a plastic case, priced at \$379 U.S., \$459 Canadian.

Lynx Design & Technology, Inc., 3880 Chesswood Drive, Downsview, Ontario, Canada M3J 2W6. Reader Service number 491.

Flood Alarm

An electronic protection

device that sounds an alarm at the first trace of water in the double floor and other locations in computer rooms is available from KF Industries, Inc., 2310 North American St., Philadelphia, PA 19133. Flood Alarm sounds a loud buzzer when it detects water in unwanted places, so that action can be taken to prevent cable and other damage. The power unit contains the power supply and buzzer as-

sembly, and the two-probe sensor unit contains solid state circuitry. As many sensors as necessary can be added to a single power unit to protect several areas at once. The Model 200 power unit costs \$30; each sensor unit is also \$30. Reader Service number 499.

Industrial and Scientific System

The Vector Graphic 3105 technical computer system includes a Vector 3 Z-80-based processor and terminal, an 18-board card cage for S-100 bus interface cards and a five-inch Winchester disk with five megabytes of storage backed by a single 630K-byte floppy disk. Available peripheral boards include a fast scan video digitizer, a high-resolution graphics module, precision 12-bit digital-to-analog converter, high-speed multichannel ADC, clock/calendar, PROM/RAM board, IEEE-488 interface, relay driver and stepper motor interface board. The system can

be tailored for pilot process control, non-destructive and other testing, biophysics, medical electronics, food technology and a wide range of electronics, physics, optical and electromechanical experiments. The basic 3105 system price is \$8495.

Vector Graphic, Inc., 500 N. Ventu Park Road, Thousand Oaks, CA 91320. Reader Service number 490.

A Quieter Printer

A new dot matrix printer has been added to the Heath/Zenith line of microcomputer peripherals. The bidirectional H-25 prints 150 cps; all 95 ASCII characters, upper/lowercase, and 33 graphics characters are included. Pitch can be varied from 10-16.5 cpi. Standard edge-punched or fanfold paper feeds easily. Paper exits from the rear of the printer and the cabinet is totally enclosed, thus reducing noise. LEDs light up to indicate when the printer is on, on-line with the computer, out of paper, jammed or has



Vector Graphic's 3105 computer system in the laboratory.

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DSM Mod I \$75.00, Mod II \$150.00, Mod III \$90.00
Disk Sort/Merge for RANDOM files. All machine language stand-alone package for sorting speed. Establish sort specification in simple BASIC command File. Execute from DOS. Only operator action to sort is to change diskettes when requested! Handles multiple diskette files! Super fast sort times — improved disk I/O times make this the fastest Disk Sort/Merge available on your TRS.
(Mod I Min 32K 2-drive system. Mod II 64K 1-drive. Mod III 32K 1-drive)

GSF (Mod I & III Tape or Disk - Specify Memory Size) Mod I \$25; Mod II \$50; Mod III \$30
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DISCAT (32K 1-drive Min)

This comprehensive Diskette Cataloging/Indexing utility allows the user to keep track of thousands of programs in a categorized library. Machine language program works with all TRSDOS and NEWDOS versions. Files include program names and extensions, program length, diskette numbers, front and back, and diskette free space.

KFS-80 (1-drive 32K Min — Mod II 64K) Mod I, III \$100.00; Mod II \$175.00
The keyed file system provides keyed and sequential access to multiple files. Provides the programmer with a powerful disk handling facility for development of data base applications. Binary tree index system provides rapid access to file records.

MAILLIST (1-drive 32K Min - Mod II 64K) Mod I, III \$75.00; Mod II \$150.00
This ISAM-based maillist minimizes disk access times. Four keys — no separate sorting. Supports 9-digit zip code and 3-digit state code. Up to 30 attributes. Mask and query selection. Record access times under 4 seconds!!

COMPROC (Mod I & Mod III — Disk only) Mod I \$20; Mod III \$30
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UTILITY PACKAGE (Mod II 64K) \$150.00
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142

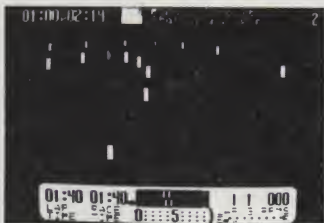
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INTERNATIONAL GRAN PRIX

an arcade-like race car simulation
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author of THREE MILE ISLAND*

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• SPECIAL FEATURES •

Five GRAND PRIX-style road circuits, including: Oulton Park, Warwick Farm, Karlskoga, and Monaco • Five speed manual or automatic transmission (with or without cruise control) • Eight levels of difficulty.

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Speeds to 198 MPH • controlled skids • spinouts • spectacular crashes • hair pin turns • narrow corners • obstacles • identified circuit features • number of laps selection • flashing last lap indicator • 'Christmas tree' controlled start • switch for silent operation • blue post marks 300' intervals • best lap/best race times posted • fully instrumented control panel: lap timer • race timer • indicator lights • edge detectors • position indicator • steering indicator • moving speed tape • lap counter • gear and RPM indicators • operating fuel gauge

RIVERBANK WILL REPLACE DAMAGED DISKS WITHIN 1 YEAR OF PURCHASE. RETURN DISK WITH PROOF OF PURCHASE PLUS FIVE DOLLARS POSTAGE AND HANDLING FOR IMMEDIATE REPLACEMENT (TEN DOLLARS OVERSEAS)

*TRADEMARK MUSE CO. BALY MD. **APPLE COMPUTER, INC. CUPERTINO, CA

Special versions for the Apple, Radio Shack, Commodore, Atari, IBM P.C., and other small systems will be available soon.

For immediate notification of availability, please send name, address, and description of system.

See December issue of *Kilobaud* for full page description or send for brochure.

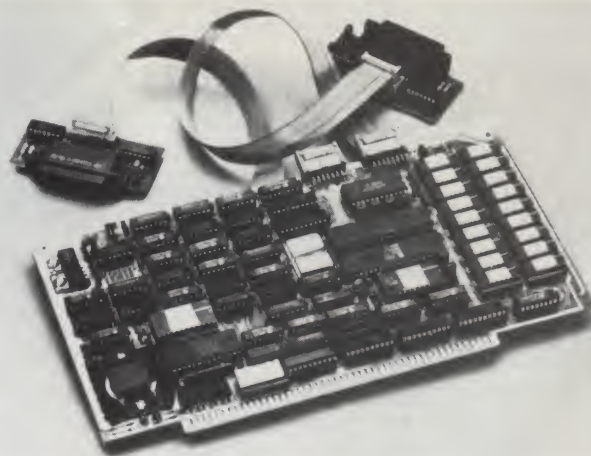
FORTH FOR/MAT™ SCREEN EDITOR A MUST FOR THE SERIOUS FORTH PROGRAMMER

- All code is Forth-79 standard. Each line of code is fully explained and flow-charted (Forth style) for easy modification.
- This editor works just like the popular word processors on the market except it is written in high level forth and is confined to the 1024 byte boundary of a forth screen.
- There are over 20 different commands for cursor positioning, text modification, tabs, relocating lines, spreading lines, and moving lines to other screens.
- Insert mode is toggled on and off for midstream insertions and deletions. Text ahead of CP is moved right during insertion and left during deletion if insert mode is on.
- Column position is displayed at all times.
- Bomb proof — all unused control codes are trapped.
- Must be used with a CRT that has cursor addressing or with a memory mapped video.
- Send check or money order in the amount of \$50.00 and receive complete source code, flowcharts, documentation, and instructions for bringing up on your system.

KV33 CORPORATION
P.O. BOX 27246
TUCSON, AZ 85726
(602) 889-5722



289



The NET/82 single board computer from MuSYS Corporation.

There is also a 26-pin parallel output for faster data transfer rates. Plug-in sensors for temperature, light, pH and other analog signals eliminate the need for building transducer circuits. Four input channels permit logging of several variables at once. Fast conversion speed of 100 μ s is sufficient for most teaching applications.

Cambridge Development

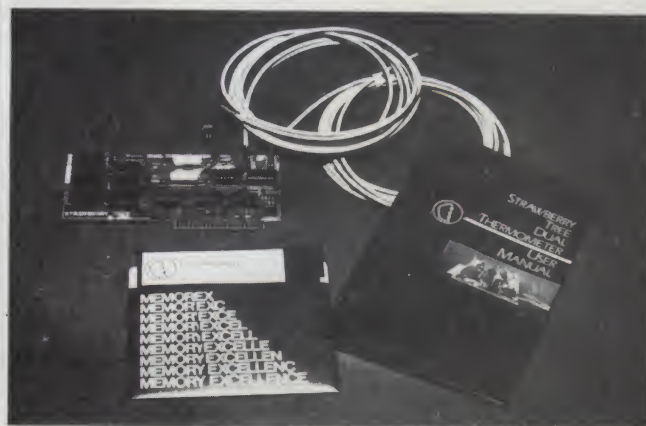
Laboratory, 36 Pleasant St., Watertown, MA 02172. Reader Service number 495.

Dual Thermometer For Apple II

Strawberry Tree Computers, 949 Cascade Drive, Sunnyvale, CA 94087, is offering an Apple II interface card with two complete thermometers and software. The system turns an Apple into a laboratory tool that measures, logs and analyzes temperature. It will display time, temperature, maximum and minimum temperatures and temperature difference between probes. An alarm will sound at any preset temperature. Just plug in the two ten-foot probes to measure temperatures from -55 to 125 degrees Celsius. The Dual Thermometer package costs \$260. Reader Service number 489.



The Analog Peripheral from Cambridge Development Laboratory.



This Dual Thermometer package from Strawberry Tree Computers converts an Apple II into a precision measurement tool.



The Heath H-25 dot matrix printer.

the cover open. Automatic test printing and status lights are built in. Price is \$1095.

Heath Company, Dept. 350-315, Benton Harbor, MI 49022. Reader Service number 498.

Software-Based Keyboard Design

The Maxi-Switch Universal Keyboard is based on the physical design of one of the first microprocessor-based keyboards, with a standard keyboard typing layout plus numeric blocks at either end. The basic unit is equipped with 103 keyswitch positions, and can be expanded at minimum cost up to 128 positions, using a prepunched panel and a circuit board with traces already in place. Simple preparation of a control EPROM, using existing routines, can equip the board to meet virtually any keyboard specifications. Performance options are selected by keyboard input or jumper and diode options. Price is \$210.

Maxi-Switch Co., 9697 E. River Road, Minneapolis, MN 55433. Reader Service number 496.

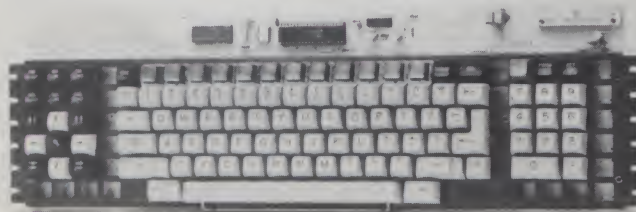
Single Board for Multi-User Systems

Complete networking capa-

bility for S-100 users, including bank-switched memory and parity checking, is available on a single board from MuSYS Corporation, 1451 Irvine Blvd., Suite 11, Tustin, CA 92680. NET/82 features a Z80A CPU, two serial ports, optional floating point processor, interrupt controller, shadow EPROM, real-time clock and S-100 parallel port for communication with the master CPU. NET/82 is compatible with MuDOS, CP/M, MP/M and CP/NET. Parity checking permits easy detection of memory malfunctions. The 128K-byte bank-switched memory option allows the program to select 48-63K of user RAM, controlled through an I/O port. Each serial port can also be customized for other applications, including interface with a serial printer. Price is \$1395; \$1995 with 128K and floating point processor. Reader Service number 497.

Data Acquisition

The Analog Peripheral is a self-contained eight-bit analog-to-digital converter with its own power supply. Its RS-232C output line is switch selectable from 110 to 9600 bits per second, and can be connected to virtually any computer, from Apple to IBM.



Maxi's Universal Keyboard.

for Apple computer with
Applesoft and
DOS 3.3

MONEYGO

The Versatile, Complete
PERSONAL BUDGET PROGRAM

NOW YOU CAN SORT AND SUMMARIZE YOUR

- Grocery Bills
- Housing, Utilities, Repairs
- Car Expenses
- Tax Deductible items
- Income

ANY FACET OF YOUR TOTAL BUDGET
With no restrictions on number of key codes or length of entry!

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- ★ OVER ANY CHECK SERIES

EVEN SUBCATEGORIZE expenses for yourself, your spouse, children, each car...even the dog!

USER TESTED for 2 years prior to national marketing!

MONEYGO* floppy disk program with complete documentation...
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- printout capability
- stores over 3000 records per disk
- automatically totals sales tax records!

KEY SOFTWARE

Apple and Applesoft are registered trademarks of Apple Computer Co.

P.O. Box 3092
Oak Ridge, TN 37830

PACIFIC OFFICE SYSTEMS

153

INCOME TAX...

PERSONAL INCOME TAX INTERVIEW PROGRAM written in BASIC by a tax attorney as he would conduct a personal interview to organize taxpayer's data into Federal income tax categories for 1981 tax returns. Program leads the user through an extensive checklist of personal events which can have income tax consequences, giving numerous examples and explanation of tax law for each YES answer.

Covers events such as marriage, divorce, birth, death, employment, lay-offs, retirement, travel, change of residence, accidents, illness or injuries, business ventures, self-employment, education, investments of money or time, prizes, scholarships, insurance recoveries, tax-exempt income, bad debts, etc., as well as the commonly known income items and deductible expenses.

Program also carries out computations for depreciation schedules, joint vs. separate returns, itemized vs. standard deductions, depreciation vs. tax credits, etc., in order to help make important tax decisions. Includes 1981 Tax law changes, references to related areas such as gift and inheritance taxes, trusts, estates, partnerships, corporations, pension and retirement plans, tax-exempt organizations, etc. Includes booklet of useful IRS tax forms, other tax publications, and toll-free phone number of tax attorney. Available on cassette or diskettes for most popular micros. Price \$49.95

OTHER POS PRODUCTS . . .

- POS-100 NRZ1 Tape Drive Controller/Formatter . . . \$795.00
- POS 800/1600 Universal Tape Drive Controller . . . \$1495.00 (4K/16K buffer, RS-232 or Parallel Ports to CPU)
- POS I/O Conversion Kit for IBM Office Selectric . . . \$150.00
- POS ASCII Printer Interface for IBM I/O Selectric . . . \$249.95
- POS IBM ASCII Selectric Printer (Parallel Interface) . . \$895.00
- GTE IS Model 560 ASCII Selectric I/O Terminal . . . \$995.00
- POS Daisy-Wheel Printer Interface for TRS-80 Model I . \$249.95
- Variable Width FORMS TRACTOR for 15" Selectrics . . \$95.00

PACIFIC OFFICE SYSTEMS
2265 Old Middlefield Way • Mt. View, CA 94043 • (415) 493-7455

OSI

TRS-80

COLOR-80

OSI

GALAXIAN - 4K - One of the fastest and finest arcade games ever written for the OSI, this one features rows of hard-hitting evasive dogfighting aliens thirsty for your blood. For those who loved (and tired of) Alien Invaders. Specify system - A bargain at \$9.95 OSI

LABYRINTH - 8K - This has a display background similar to MINOS as the action takes place in a realistic maze seen from ground level. This is, however, a real time monster hunt as you track down and shoot mobile monsters on foot. Checking out and testing this one was the most fun I've had in years! - \$13.95. OSI

THE AARDVARK JOURNAL

FOR OSI USERS - This is a bi-monthly tutorial journal running only articles about OSI systems. Every issue contains programs customized for OSI, tutorials on how to use and modify the system, and reviews of OSI related products. In the last two years we have run articles like these!

- 1) A tutorial on Machine Code for BASIC programmers.
- 2) Complete listings of two word processors for BASIC IN ROM machines.
- 3) Moving the Directory off track 12.
- 4) Listings for 20 game programs for the OSI.
- 5) How to write high speed BASIC - and lots more -

Vol. 1 (1980) 6 back issues - \$9.00

Vol. 2 (1981) 4 back issues and subscription for 2 additional issues - \$9.00.

ADVENTURES!!!

For OSI, TRS-80, and COLOR-80. These Adventures are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are interactive fantasies. It's like reading a book except that you are the main character as you give the computer commands like "Look in the Coffin" and "Light the torch".)

Adventures require 8K on an OSI and 16K on COLOR-80 and TRS-80. They sell for \$14.95 each.

ESCAPE FROM MARS (by Rodger Olsen)

This ADVENTURE takes place on the RED PLANT. You'll have to explore a Martian city and deal with possibly hostile aliens to survive this one. A good first adventure.

PYRAMID (by Rodger Olsen)

This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!

TREK ADVENTURE (by Bob Retelle)

This one takes place aboard a familiar starship. The crew has left for good reasons - but they forgot to take you, and now you are in deep trouble.

DEATH SHIP (by Rodger Olsen)

Our first and original ADVENTURE, this one takes place aboard a cruise ship - but it ain't the Love Boat.

VAMPIRE CASTLE (by Mike Bassman)

This is a contest between you and old Drac - and it's getting a little dark outside. \$14.95 each.

OSI

NEW-NEW-NEW TINY COMPILER

The easy way to speed in your programs. The tiny compiler lets you write and debug your program in Basic and then automatically compiles a Machine Code version that runs from 50-150 times faster. The tiny compiler generates relocatable, native, transportable machine code that can be run on any 6502 system.

It does have some limitations. It is memory hungry - 8K is the minimum sized system that can run the Compiler. It also handles only a limited subset of Basic - about 20 keywords including FOR, NEXT, IF THEN, GOSUB, GOTO, RETURN, END, STOP, USR(X), PEEK, POKE, . = , * , / , < > . Variable names A-Z, and Integer Numbers from 0-64K.

TINY COMPILER is written in Basic. It can be modified and augmented by the user. It comes with a 20 page manual.

TINY COMPILER - \$19.95 on tape or disk OSI

SUPERDISK II

This disk contains a new BEXEC* that boots up with a numbered directory and which allows creation, deletion and renaming of files without calling other programs. It also contains a slight modification to BASIC to allow 14 character file names.

The disk contains a disk manager that contains a disk packer, a hex/dec calculator and several other utilities.

It also has a full screen editor (in machine code on C2P/C4) that makes corrections a snap. We'll also toss in renumbering and program search programs - and sell the whole thing for - SUPERDISK II \$29.95 (5 1/4") OSI

BARE BOARDS FOR OSI C1P

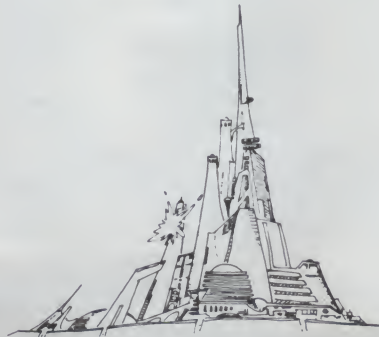
MEMORY BOARDS!!! - for the C1P - and they contain parallel ports!

Aardvarks new memory board supports 8K of 2114's and has provision for a PIA to give a parallel ports! It sells as a bare board for \$29.95. When assembled, the board plugs into the expansion connector on the 600 board. Available now!

PROM BURNER FOR THE C1P - Burns single supply 2716's. Bare board - \$24.95.

MOTHER BOARD - Expand your expansion connector from one to five connectors or use it to adapt our C1P boards to your C4/8P. - \$14.95.

16K RAM BOARD FOR C1P - This one does not have a parallel port, but it does support 16K of 2114's. Bare Board \$39.95.



Please specify system on all orders

This is only a partial listing of what we have to offer. We offer over 120 games, ROMS, and data sheets for OSI systems and many games and utilities for COLOR-80 and TRS-80. Send \$1.00 for our catalog.

AARDVARK TECHNICAL SERVICES, LTD.
2352 S. Commerce, Walled Lake, MI 48088
(313) 669-3110

✓91



COLOR-80

WORD PROCESSING THE EASY WAY - WITH MAXI-PROS

This is a line-oriented word processor designed for the office that doesn't want to send every new girl out for training in how to type a letter.

It has automatic right and left margin justification and lets you vary the width and margins during printing. It has automatic pagination and automatic page numbering. It will print any text single, double or triple spaced and has text centering commands. It will make any number of multiple copies or chain files together to print an entire disk of data at one time.

MAXI-PROS has both global and line edit capability and the polled keyboard versions contain a corrected keyboard routine that make the OSI keyboard decode as a standard typewriter keyboard.

MAXI-PROS also has sophisticated file capabilities. It can access a file for names and addresses, stop for inputs, and print form letters. It has file merging capabilities so that it can store and combine paragraphs and pages in any order.

Best of all, it is in BASIC (OS65D 51/4" or 8" disk) so that it can be easily adapted to any printer or printing job and so that it can be sold for a measly price.

MAXI-PROS - \$39.95. Specify 5 1/4" or 8" disk.

SUPPORT ROMS FOR BASIC IN ROM MACHINES - C1S/C2S. This ROM adds line edit functions, software selectable scroll windows, bell support, choice of OSI or standard keyboard routines, two callable screen clears, and software support for 32-64 characters per line video. Has one character command to switch model 2 C1P from 24 to 48 character line. When installed in C2 or C4 (C2S) requires installation of additional chip. C1P requires only a jumper change. - \$39.95
C1E/C2E similar to above but with extended machine code monitor. - \$59.95 OSI

ARCADE GAMES FOR OSI, COLOR-80 AND TRS-80 (8K OSI, 16K TRS-80 AND COLOR-80)

TIMETREK - A REAL TIME, REAL GRAPHICS STARTRECK. See your torpedoes hit and watch your instruments work in real time. No more unrealistic scrolling displays! \$14.95.

STARFIGHTER - This one man space war game pits you against spacecruisers, battlewagons, and one man fighters, you have the view from your cockpit window, a real time working instrument panel, and your wits. Another real time goody. \$9.95

BATTLEFLEET - This grown up version of Battleship is the toughest thinking game available on OSI or 80 computers. There is no luck involved as you seek out the computers hidden fleet. A topographical toughie. \$9.95

QUEST - A NEW IDEA IN ADVENTURE GAMES! Different from all the others, Quest is played on a computer generated map of Alesia. Your job is to gather men and supplies by combat, bargaining, exploration of ruins and temples and outright banditry. When your force is strong enough, you attack the Citadel of Moorlock in a life or death battle to the finish. Playable in 2 to 5 hours, this one is different every time.
16K COLOR-80 OR TRS-80 ONLY. \$14.95



OSI

Byte Your Way to Good Nutrition

Apple Statistics

Make Music with VIC

Understanding Asian Languages

Diet Analysis

Nutri-Calc is a nutritional analysis program designed to rapidly and accurately assess individual nutrient intake. Eighteen of the nutrients found in 730 common foods are included. Nutrient values have been taken from standard USDA listings. The user can modify the food and nutrient database as needed. Comparisons of input data to the recommended daily allowances for specific subgroups is provided; calculations are based on age and sex, and for infants, body weight. Nutri-Calc lets the user build new food items (over 200) by combining components already in the foods database. Standard menus and special recipes can also be stored. The program can be used with Apple II+, TRS-80 Models II and III, and any CP/M or UCSD p-System microcomputers with 64K-byte memory and eight-inch single-density disk drives. Price is \$350.

PCD Systems, Inc., PO Box 143, Penn Yan, NY 14527. Reader Service number 464.

Statistics For the Apple

Rainbow Computing, 19517 Business Center Dr., Northridge, CA 91324, offers a comprehensive statistics package for the Apple II with Applesoft and DOS 3.3. Statistics with Daisy offers a full range of statistical capabilities for business, scientific and social science applications. It features Help and Info

functions to simplify operation. The system does math and time-series transforms, hi-resolution plots, basic statistics, correlations, multiple regression (six different procedures), model testing and evaluation, nonparametric statistics, hypothesis testing and analysis of variance. Users can add their own programs as new Daisy commands. Data is entered through a window view into the data table. Statistics with Daisy is priced at \$79.95. Reader Service number 465.

Music Composer

Turn your VIC microcomputer into a music machine with VIC Piper. This program lets you compose, save, recall and play back music, using a standard VIC without additional hardware. You enter notes by using alpha notation: A, F#, C, G, D; rests and note duration are also entered at the keyboard. You can vary the volume and tempo, play harmony, print pictures of text to accompany your music and automatically load and run additional compositions from cassette or disk. Price is \$25, including manual and sample compositions.

Abacus Software, PO Box 7211, Grand Rapids, MI 49510. Reader Service number 466.

Professional Tax Preparation

The Income Tax Preparation system by Micro-Tax, Microcomputer Taxsystems,

Inc., 22713 Ventura Blvd., Suite F, Woodland Hills, CA 91364, is designed to computerize the tax professional's office. The system accepts the data, summarizes needed information, computes tax and prints the required IRS and state forms. The tax specialist can provide clients with immediate results. Micro-Tax offers the system in three levels, priced from \$250-\$1000. Reader Service number 467.

Asian Languages Program

Asiagraphics software enables people using Asian languages, with their many thousands of ideographic characters, to use computer technology for word processing, data processing, telex and other applications. A specific character is selected by typing a unique code (descriptor) on a standard keyboard; the character is displayed on the video screen. Both traditional and simplified characters are available. The descriptor consists of the phonetic representation of the character's pronunciation and a phonetic rendering of the radical family to which the character belongs. The operator must be literate in the language used and know the phonetic system which the descriptors are based. Using touch typing, speeds comparable to western language typing speeds can be achieved. Descriptors for more than 6600 characters currently exist in memory; new characters can be entered at any time by drawing

the needed character on a grid with the character generator program.

China Institute in America, Inc., 125 East 65th St., New York, NY 10021. Reader Service number 469.

Spelling Help for Your 6809

A misspelled word that slips by your secretary but is noticed by a potential customer will cost you sales; spelling errors in a manuscript almost guarantee a rejection slip. Spell-Test will help you find those deadly spelling errors. Spell-Test, for Flex-based 6809 microcomputers, is completely menu-driven. The program stops and points to all invalid words, so you can Accept the word as it is, Accept and Save it for use in an optional dictionary later or Replace it. You can do a quick check of your prose with the basic 11,000-word dictionary or a thorough check against a comprehensive 21,000-word dictionary. Spell-Test on a standard Flex disk costs \$195.

Frank Hogg Laboratory, 130 Midtown Plaza, 700 East

謹订于十月二十三日, 星期五, 上午十一时假华美协进社二楼图书室举行中文电脑打字程式系统示范表演, 届时恭请光临。

华美协进社謹订

The China Institute in America has introduced the Asiagraphics Software System.

Water St., Syracuse, NY 13210. Reader Service number 471.

Computerized Ratings

Media Service Concepts, 1713 N. North Park Ave., Chicago, IL 60614, has introduced Recall, a radio ratings analysis package for use on the Apple II. Recall lets a radio station quickly organize and interpret data furnished by Arbitron, the major radio ratings service. Recall can analyze up to four radio stations or four rating books simultaneously. The different sections provide in-depth understanding of radio audience flow dynamics and market positioning. Recall can help a radio station find its strengths and weaknesses, and those of competitors. Recall is priced at \$750. Reader Service number 468.

Apple Graphics

The Superplotter is a pro-

fessionally-oriented graphics package for business, engineering, education and math applications. The program features pie graphs, standard bar charts, point and line graphs, a mathematical function plotter, a least squares polynomial curve-fit generator, automatic graphics disk storage and recall, a data file editor, overlay modes, a user tutorial and keyboard image shapes that can be mixed with the user's own graphics displays. The program runs on Apple computers with Applesoft. Price is \$59.95.

Dickens Data Systems, 433 Greenwood Drive, LaPlace, LA 70068. Reader Service number 472.

Econometric Software

WITS World Information and Technology Systems Corp., 235 Yorkland Blvd., Suite 901, Willowdale, Ontario M2J 4W9, has announced WITS/Economist, a software package that helps business-

people develop financial and marketing strategies. WITS/Economist is used for profitability and break-even analysis; capital budgeting, investment, pricing and marketing/advertising decisions; and competitive and risk analysis. To model a business the user types in the key business parameters that describe anticipated economic, financial and marketing conditions. WITS/Economist presents the resulting business scenario and guides the user interactively through price-sale optimization and risk analysis. WITS/Economist is available on Heath/Zenith systems under CP/M and HDOS. It requires 48K bytes of memory and one disk drive. Price is \$495 (Canadian). Reader Service number 470.

Hi-Res Graphics For Atari

Versa Computing, Inc., 3541 Old Conejo Road, Suite 104, Newbury Park, CA 91320, has a complete joystick/paddle graphics software package for 32K Atari

400/800 computers. With Graphics Composer you can use paddles or joystick to draw a picture outline on hires screen Mode 8 or 7. Then use color fill-in, color brushes and Add Text to complete your graphics designs. Graphics Composer lets you create player/missile shapes to use in other programs. The geometric figures program lets you define circles, triangles, polygons, parallelograms and even trigonometric curves. Loading routines are provided so that pictures can be used in other programs or traded with friends. Price is \$39.95, on disk or cassette. Reader Service number 474.

Two Investment Broker Systems

Kate's Computers offers investment programs for North Star, Apple and CP/M users. The AnalySt is a comprehensive stock market graphics system. It features graphics plotting using seven different techniques on a screen that can be triple split. The Ad-

SPEED POWER EFFICIENCY OSI 65D3 SYSTEMS

R-EDIT: Edit any program or text with ease! \$40

- FULL CURSOR control. Insert, delete, add anywhere on the screen.
- BASIC, assembler, etc. edited without reloading RAM-resident editor.
- SYSGEN relocates R-EDIT and customizes.

SPUL65: Printer Spooler & Virtual Indirect File \$95/\$10

- DON'T WAIT for your printer. Process words. Write programs. Put multiple print jobs in the queue. Keep working while the printer runs!
- TWD printers accommodated on any ports. Multiple copies with pagination.
- SYSGEN relocates SPUL65 and allows extensive customization.
- VIRTUAL INDIRECT FILES on disk. End space problems when using temporary files. Now do extensive editing of BASIC with your word processor.

XREF: BASIC Cross Referencer \$25

- TABULATES: Referenced line numbers, all variable names, and functions.
- FAST machine language program.
- DISK based to handle the largest BASIC source files on any drive.

FBASIC: BASIC Compiler \$155/\$10

- FAST machine code now can be written with the ease of BASIC.
- SPEED-optimized, native-code compiler. An integer subset of OSI's BASIC.
- DISK based to allow large source and object files.
- EXTENSIONS to BASIC for: Easy interface to system hardware/software. Direct access to 6502 registers. Array initialization and optional absolute location. WHILE and other structures. Interfacing compiler output and interpreter.
- UTILITIES (plus source), manual, and many useful examples.

CP/M to OSI Translation

Frustrated by all those good CP/M disks that won't run on your OSI CP/M system? Send us your disk, \$15, and we'll send it back with an OSI compatible version.

Manual orders applied to software purchases. Programs supplied on 8-in. single-density, single-sided disks. Hawaii residents add 4% tax.



113

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DUAL

THERMOMETER

For Apple II*
COMPLETE with SOFTWARE



- Display temperature, maximum, minimum and difference.
- Sound alarm for over/under temperature.
- Store data on disk or printer automatically.
- Display time with on-

board timer.

- Up to 7 boards with 14 probes in one Apple*.
- -55°C to 125°C range, 0.4° accuracy over most of range.
- Requires 48K Apple* with Applesoft* and disk.

Strawberry Tree Computers

Dept. M
949 Cascade Drive
Sunnyvale, Ca. 94087
(408) 736-3083



\$260.00

If your dealer doesn't have it, call or write us.

*TM of Apple Computer, Inc.

66

vi\$or is a stocks and bonds portfolio management system featuring immediate access to all options, stocks, bonds and commodities held, and detailed information about each. Both programs have access to four on-line quote services, with software to automatically update. The Analy\$ is \$425; Adv\$or is \$375; the price for both is \$750. Add \$95 for CP/M versions.

Kate's Komputers, PO Box 1675, Sausalito, CA 94965. Reader Service number 475.

Multi-Tasking Kernel

The Multi-Tasking Kernel from U.S. Software, 5470 NW Innisbrook Place, Portland, OR 97229, is a tool for integrating multiple real-time software tasks. It is burned into read-only memory, and oversees the selection and execution of each task. The kernel is small, fast and easy to use. The Multi-Tasking Kernel is documented, tested and available in source assembly form for the 8085, Z-80, 6502,

6800 and 6809 microprocessors. The package provides source code for a basic multi-tasking organization (tasks self-schedule in a round-robin ordering). The user is guided through a series of enhancements for implementing sophisticated interrupt-initiated, preemptive priority, dynamic task scheduling. Also included are descriptions of dedicated and shared-resource scheduling, time-slice scheduling and intertask communication schemes. Price is \$195 for full internal use rights and unlimited rights to distribute kernel-based products in machine form. Reader Service number 476.

\$\$\$

Level 10 offers a \$5000 reward for the return of the Alkemstone. Their new computer adventure challenges you to recover the missing Alkemstone from the underground lair in which it has been concealed. Unusual messages, fragments of words, sketches

and other clues written on the cave walls will lead you to the treasure. And the first player to describe its exact location to Level 10's designated judge wins \$5000. The game features hi-resolution graphics, three-dimensional animation, sound effects and an illustrated short story. It runs on an Apple with 48K and one 16-sector disk drive.

Level 10 Division, Dakin5 Corp., 7475 Dakin St., Suite 507, Denver, CO 80221. Reader Service number 477.

Software Development

Genesis is a professional program generator that accepts commands in conversational English, has ample memory capacity to code difficult algorithms and generates efficient code faster than four lines per second. Genesis runs on all CP/M 2.XX systems and uses compiled PL/1-80, although PL/1-80 is not required to run the program. Code is generated in CBASIC. The program comes with on-



Genesis program generator from Time Management Software.

line documentation and a complete manual. Price is \$500.

Time Management Software, 123 E. Broadway, PO Box 727, Cushing, OK 74023. Reader Service number 478.

Language Hybrid

Starside Engineering, PO Box 8306, Rochester, NY 14618, offers the RUNIC 1.0 threaded interpreted language, on CP/M disk, in various popular microcomputer formats. RUNIC has its roots

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in FORTH, but is more easily read and maintained than FORTH code. RUNC implements higher-level data structures than FORTH, including integers, floats and character strings. RUNC uses RPN to evaluate its expressions, but its control structures are closer to those of Pascal, BASIC and other algebraic languages. Price is \$52.95. Reader Service number 479.

VisiPeek

Micro-Sparc. Box 325, Lincoln, MA 01773, has released a utility for users of Personal Software's VisiCalc on the Apple II. Apple VIP (VisiCalc Info Printer) reads VisiCalc files and produces listings of the formats, formulas, variables and other VisiCalc grid elements. Labels and formulas appear in their complete, untruncated form. VIP lets you examine individual elements, selected areas of the grid or the entire VisiCalc sheet. Files can be listed in either row or column sequence, sorted alphabetically by column. Ap-

ple VIP requires Applesoft; specify DOS 3.2 or 3.3 version. Price is \$23.45. Reader Service number 480.

Space Waste Race

Storybooks of the Future, 527-41st Ave., San Francisco, CA 94121, has announced Space Waste Race, a computerized storybook for young children. This program for the TRS-80 includes animated graphics, music, sound effects and contextual learning activities. The learning games involve the story's graphics or ideas. The story tells about the moon getting jealous when a giant rocket ship brings all the earth's wastes into space to form a new garbage "moon." A silly moon race ensues that ends in collision—and the fallout can go either way. Space Waste Race is available on cassette or disk for Models I and III. The 32K program costs \$24.95; the slimmer 16K version (storybook with three games only) is \$19.95. Reader Service number 481.

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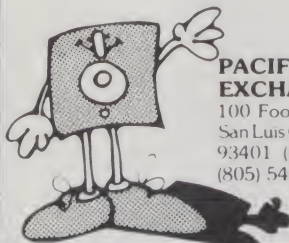
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CONVERSIONS "I"

Fifteen Puzzle

This program is a conversion of William L. Colsher's Fifteen Puzzle (*Kilobaud Microcomputing*, February 1981, p. 114) from TRS-80 Level I to Level II. It is contributed by E. L. Green, 890 Montego Bay Drive, Merritt Island, FL 32952.

Kilobaud Microcomputing welcomes and encourages such conversions of programs that appear in the magazine.

Program listing.

```

5      REM*** FIFTEEN PUZZLE FROM MICROCOMPUTING FEB 81 PG 114
10     REM*** BY WILLIAM L. COLSHER - LISLE, ILL 60531
20     REM*** MODIFIED BY E.L. "LANE" GREEN - 890 MONTEGO BAY DR.
ERRITT ISLAND, FL 32952 - TO RUN AS A LEVEL II PROGRAM FOR TRS 8
0.
25     DIMA(16)
30     CLS:INPUT "DO YOU NEED INSTRUCTIONS (Y=1, N=2)";A:IF A=1 THEN GOSUB 10000
40     CLS:M=0:PRINT "GENERATING THE PUZZLE TAKES A WHILE. PLEASE WAIT."
50     FOR I=1 TO 16: A(I)=0:NEXT I
60     FOR I=1 TO 16
70       R=RND(16)
80       IF A(R)<>0 THEN 70
90       A(R)=I
100    NEXT I
110    GOSUB 5000
120    IF F=1 THEN 50
130    GOSUB 6000
140    PRINT " ";INPUT "YOUR MOVE":X
145    GOSUB 4000
150    GOSUB 7000
160    IF F<>0 THEN 180
170    PRINT "ILLEGAL MOVE, RE-ENTER": FOR I=1 TO 500:NEXT I:GOTO 130
180    A(X+F)=A(X):A(X)=16
190    GOTO 8000
200    M=M+1: GOTO 130
999    END
4000    REM*** CONVERT NUMBER TO LOCATION IN ARRAY
4010    FOR I=1 TO 16
4020      IF A(I)=X THEN 4040
4030    NEXT I
4040    X=I
4050    RETURN
5000    REM*** VERIFY SOLUTION POSSIBLE
5005    F=1
5010    S=0
5020    FOR I=1 TO 15
5030      FOR J=I+1 TO 16
5040        IF A(I)>A(J) THEN S=S+1
5050      NEXT J: NEXT I
5060    FOR I=1 TO 8
5070      READ X
5080      IF A(X)=0 THEN S=S+1
5090    NEXT I
5095    RESTORE
5100    A=INT(S/2)
5110    IF A*2=S THEN F=0
5120    RETURN
5130    DATA 2, 4, 5, 7, 10, 12, 13, 15
6000    REM*** DISPLAY GAME BOARD
6005    CLS: L=339:PRINT@217,"MOVE ";M
6010    FOR I=1 TO 4
6015      PRINT@L," ";
6020      FOR J=1 TO 4
6025        N=A((I-1)*4+J)
6028        IF N=16 THEN N=0
6030        IF N<10 THENPRINT " ";N:;GOTO 6040
6038        IF (N=10)OR(N=16) THEN PRINTN;
6040      NEXTJ
6050      L=L+64
6060    NEXT I
6070    RETURN
7000    REM*** CHECK FOR LEGAL MOVE
7010    F=0
7015    IF X+1=16 THEN 7025
7020    IF A(X+1)=16 THEN F=1
7025    IF X-1<=0 THEN 7035
7030    IF A(X-1)=16 THEN F=-1
7035    IF X+4=16 THEN 7045
7040    IF A(X+4)=16 THEN F=4
7045    IF X-4<=0 THEN 7060
7050    IF A(X-4)=16 THEN F=-4
7060    RETURN
8000    REM*** CHECK FOR A WIN
8010    FOR I=1 TO 16
8020      IF A(I)=I THEN200
8030    NEXT I
8040    GOSUB 6000
8050    PRINT " ";PRINT " "
8060    PRINT "CONGRATULATIONS!!! YOU DID IT IN ONLY";M;"MOVES!!!"
8070    PRINT " ";INPUT "TO PLAY AGAIN, HIT 'ENTER'.";A#
8080    GOTO 10

```

More →

Listing continued.

```
10000 REM*** INSTRUCTIONS
10010 CLS:PRINT@18,"F I F T E E N P U Z Z L E"
10020 PRINT@128,"THE OBJECT OF THE FIFTEEN PUZZLE IS TO MOVE THE"
10030 PRINT"NUMBERS AROUND SO THAT THEY ARE IN ORDER FROM 1 TO 15."
10040 PRINT"A MOVE IS MADE BY TYPING IN THE NUMBER (WHICH MUST BE "
10050 PRINT"ADJACENT TO THE ZERO) YOU WISH TO MOVE. THAT NUMBER IS"
10060 PRINT"THEN EXCHANGED WITH THE ZERO. YOU WIN WHEN THE BOARD"
10065 PRINT"LOOKS LIKE THIS:"
10070 PRINT " ":PRINT " ":PRINT"1 2 3 4":PRINT"5 6 7 8":PRINT"9 10 11 12"
10080 PRINT"13 14 15 0"
10090 PRINT " ":INPUT"HIT 'ENTER' TO PLAY":A$
10100 RETURN
```

CONVERSIONS "II"

A "Personable" Calendar

This conversion of G.R. Boynton's Personable Calendar program for the PET (Aug. 1980, p. 168) is written in Applesoft BASIC. The author has added one-key inputs and a printer prompt for a printed calendar of appointments. The printed sheet can list for a specific day or for a full month. To print out a monthly calendar when prompted to enter the date, simply enter the month only. (Contributed by Kenneth M. Jenkins, 915 S. 12th St., Gadsden, AL 35901.)

Program listing.

```
5 HOME : VTAB 5
10 PRINT "PLEASE TYPE IN YOUR GREETING !>>>>"
20 VTAB 20
21 INPUT "HERE >>:";G$
30 FOR I = 1 TO LEN (G$)
40 IF MID$ (G$,I, LEN ("KEN")) = "KEN" THEN NA$ = "KEN"
50 NEXT I
60 IF NA$ = "KEN" THEN GOTO 1010
70 HOME : INPUT "MY NAME IS 'ISAAC'. WHAT IS YOUR NAME? ";NA$
90 GOSUB 1110
92 PRINT
95 HOME : VTAB 12
97 PRINT "ENTER DATE AS (EX. AUGUST 01)"; PRINT
100 INPUT "WHAT IS THE DATE TODAY? ";D$
120 GOTO 2010
890 HOME
900 PRINT "THE PROGRAM IS MADE UP OF THE FOLLOWING"
902 PRINT "COMPONENTS:"
903 PRINT : PRINT : PRINT
904 PRINT TAB( 5)"1 - CONTROL FOR HELLO"
906 PRINT TAB( 5)"10-120"
908 PRINT TAB( 5)"2 - GREETINGS KEN"
910 PRINT TAB( 5)"1000-1099"
912 PRINT TAB( 5)"3 - GREETINGS OTHER"
914 PRINT TAB( 5)"1100-1199"
916 PRINT TAB( 5)"4 - READ DATA FOR CALENDAR"
918 PRINT TAB( 5)"2000-2140"
920 PRINT TAB( 5)"5 - ROUTE FOR CALANDAR SUBR'S"
922 PRINT TAB( 5)"2145-2299"
924 PRINT TAB( 5)"6 - TODAY'S EVENTS"
926 PRINT TAB( 5)"2300-2330"
928 PRINT : PRINT "HIT 'RETURN' TO GET THE REST"
930 GET A$: HOME : IF A$ = "" THEN 930
932 VTAB 10
936 PRINT TAB( 5)"7 - OTHER DATES"
938 PRINT TAB( 5)"2400-2450"
940 PRINT TAB( 5)"8 - UNFINISHED ITEMS"
942 PRINT TAB( 5)"2500-2599"
944 PRINT TAB( 5)"9 - CHANGE STATUS OF ITEMS"
946 PRINT TAB( 5)"2600-2699"
948 PRINT TAB( 5)"10- ADD ITEMS TO CALENDAR"
950 PRINT TAB( 5)"2700-2799"
956 PRINT TAB( 5)"11- WRITE TO DISK"
958 PRINT TAB( 5)"2800-2898"
960 PRINT TAB( 5)"12- SEARCH BY DATE"
962 PRINT TAB( 5)"2900-2999"
968 PRINT : PRINT "HIT 'RETURN' FOR CALENDAR "
970 GET A$: HOME : IF A$ = "" THEN 970
979 GOTO 2190
980 IF FRE (0) > 200 THEN 987
981 HOME
982 VTAB 12: PRINT "THERE IS VERY LITTLE SPACE LEFT IN MEMORY"
983 PRINT : INPUT "DO YOU WANT TO DELETE ALL OF THE ITEMS THAT ARE FINIS
HED?";A$
```

More

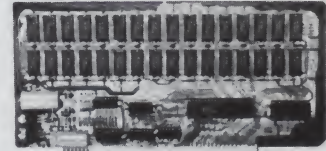
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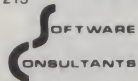
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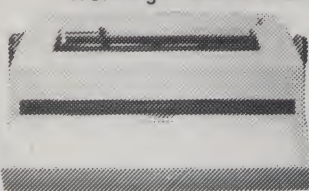


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Listing continued.

```

985 IF A$ = "Y" THEN E = 1: GOSUB 2510
986 GOTO 996
987 HOME : IF CH < = WR THEN 995
988 VTAB 12: PRINT "THERE ARE ONE OR MORE CHANGES THAT HAVE NOT BEEN REC
ORDED."
989 INPUT "DO YOU WANT TO WRITE THEM TO DISK?"A$
990 IF A$ = "Y" THEN GOSUB 2810
995 HOME
996 VTAB 12: PRINT TAB( 20)"GOODBYE!" "NA$
998 PRINT TAB( 20)"GLAD I COULD HELP YOU."
999 FOR I = 1 TO 3000: NEXT I: HOME : PRINT CHR$( 4);"RUN DISK #21"
1000 REM HELLO KEN
1010 LET N = INT (( RND (1) * 10) / 2.5) + 1
1020 ON N GOSUB 1035,1045,1055,1065
1025 FOR K = 1 TO 1500: NEXT K
1030 GOTO 92
1035 HOME : VTAB 12: HTAB 30
1040 PRINT "HELLO DESIGNER": RETURN
1045 HOME : VTAB 12: HTAB 30
1050 PRINT "BACK TO WORK, EH?": RETURN
1055 HOME : VTAB 12: HTAB 30
1060 PRINT "HI, KEN": RETURN
1065 HOME : VTAB 12: HTAB 30
1070 PRINT "HOWDY, KEN": RETURN
1100 REM OTHERS
1110 HOME : VTAB 12: PRINT NA$ " ..I AM A CALENDAR OF THINGS"
1120 PRINT "TO BE DONE."
1130 PRINT "I HELP KEN KEEP UP WITH HIS WORK."
1135 FOR K = 1 TO 1500: NEXT K
1140 PRINT "HE TELLS ME WHAT HE HAS TO DO ON EACH"
1150 PRINT "DAY, AND I REMIND HIM ABOUT WHAT IS ON"
1160 PRINT "FOR TODAY, AND WHAT HE HAS NOT FINISHED."
1170 FOR K = 1 TO 6500: NEXT
1180 RETURN
2000 REM CALENDAR ROUTINE
2005 FOR I = 1 TO 2000: NEXT I
2010 HOME : VTAB 12
2015 PRINT "FIRST I HAVE TO READ THE CALENDAR---"NA$
2016 PRINT
2017 HTAB 25
2020 PRINT "CAN YOU WAIT? "": GET A$
2021 HOME
2023 IF A$ = "Y" THEN GOTO 2045
2025 HOME : VTAB 12
2040 IF LEFT$(A$,1) < > "Y" THEN PRINT "NOTHING HAPPENS "NA$ " WITHOU
T READING THE DISK-FILE FIRST !": GOTO 2000
2045 HOME : VTAB 12
2050 L = 1:D = 1:C = 0:F$ = "MEMOS"
2060 PRINT CHR$( 4);"OPEN "F$
2065 PRINT CHR$( 4);"READ "F$
2070 INPUT N
2080 J = N + 10
2090 DIM DA$(J),IT$(J),ST$(J)
2100 FOR K = 1 TO N
2110 : INPUT DA$(K),IT$(K),ST$(K)
2130 NEXT K
2140 PRINT CHR$( 4);"CLOSE "F$
2150 HOME : VTAB 12
2155 PRINT "WOULD YOU LIKE TO SEE WHAT IS ON FOR "
2160 PRINT "TODAY? "": GET A$
2165 HOME : VTAB 12
2180 IF A$ = "Y" THEN GOSUB 2310
2190 PRINT "WHAT'S NEXT "NA$"? (TYPE FIRST WORD OF SELECTION).
2195 PRINT : PRINT
2200 PRINT TAB( 10)"OTHER DATES"
2210 PRINT TAB( 10)"PAST ITEMS NOT COMPLETE"
2220 PRINT TAB( 10)"STATUS UPDATE"
2230 PRINT TAB( 10)"ADDITIONS"
2240 PRINT TAB( 10)"TODAY"
2245 PRINT TAB( 10)"COMPONENTS OF PROGRAM"
2250 PRINT TAB( 10)"DONE WITH CALENDAR"
2252 PRINT : PRINT : PRINT "WHICH? >>:"": GET A$
2260 IF A$ = "O" THEN RO = 1
2265 IF A$ = "P" THEN RO = 2: REM 2510
2270 IF A$ = "S" THEN RO = 3: REM 2605
2275 IF A$ = "A" THEN RO = 4: REM 2705
2280 IF A$ = "T" THEN RO = 5: REM 2310
2283 IF A$ = "C" THEN GOSUB 890
2285 IF A$ = "D" THEN 980
2290 ON RO GOSUB 2400,2500,2600,2700,2300,900
2295 GOTO 2190
2300 REM TODAY
2310 SE$ = D$
2320 GOSUB 2900
2330 RETURN
2400 HOME : VTAB 12
2402 PRINT "FOR SPECIFIC DATE..TYPE MONTH & DAY (EX.JUNE 23)"
2404 PRINT "FOR FULL MONTH'S SCHEDULE..TYPE MONTH ONLY (EX.JUNE)": PRINT
2410 INPUT "WHICH DATE ARE YOU LOOKING FOR?"DB$
2430 HOME :SE$ = DB$
2440 GOSUB 2900
2450 RETURN
2500 HOME : VTAB 12
2510 PRINT "HERE IS WHAT'S HANGING OVER YOUR HEAD!"
2515 PRINT
2520 FOR K = 1 TO N
2525 IF E = 1 AND ST$(K) = "NOT FINISHED" THEN NN = NN + 1

```

More

Listing continued.

```

2530 IF ST$(K) = "FINISHED" THEN GOTO 2540
2535 IF ST$(K) = "NOT FINISHED" THEN GOTO 2560
2540 NEXT K
2545 IF E = 1 THEN 2810
2550 RETURN
2560 PRINT MID$(DA$(K),1, LEN(DA$(K)) - 2)
2565 PRINT "ITEM # " RIGHT$(DA$(K),2)
2570 PRINT IT$(K)
2575 PRINT
2580 FOR Z = 1 TO 1500: NEXT Z
2590 GOTO 2540
2600 HOME: VTAB 12
2605 PRINT "WHAT IS THE DATE OF THE ITEM YOU WANT"
2610 INPUT "TO CHANGE?";DB$
2620 PRINT: PRINT "DO YOU WANT TO LOOK AT THE ITEMS FOR"
2630 PRINT "THAT DATE FIRST?"; GET A$
2633 HOME: VTAB 12
2635 IF A$ = "Y" THEN GOSUB 2430
2640 INPUT "WHAT IS DATE AND ITEM NUMBER TO BE CHANGED?";DI$
2650 PRINT: PRINT "IS THE NEW STATUS TO BE 'FINISHED' OR"
2660 INPUT "'NOT FINISHED' ?";ST$
2665 FOR K = 1 TO N
2670 IF DI$ = DA$(K) THEN ST$(K) = ST$
2675 NEXT K
2677 HOME: VTAB 12
2680 CH = CH + 1: PRINT "OK, THE CHANGE IS MADE. DO YOU WANT TO MAKE ANOT
HER CHANGE?"; GET A$
2685 HOME
2690 IF A$ = "Y" THEN 2605
2695 RETURN
2700 REM ADDITIONS
2705 HOME: VTAB 12
2710 INPUT "WHAT IS THE DATE OF NEW ENTRY?";DB$
2715 HOME: VTAB 10
2717 PRINT "SINCE YOU HAVE TO GIVE AN ITEM NUMBER"
2720 PRINT "AS WELL AS THE DATE DO YOU WANT TO"
2725 PRINT "LOOK AT THE ITEMS FOR THAT DATE?"; GET A$
2727 HOME: VTAB 12
2730 IF A$ = "Y" THEN GOSUB 2430
2735 INPUT "WHAT IS THE DATE AND ITEM NUMBER?";DA$(N + 1)
2737 HOME: VTAB 10
2740 INPUT "WHAT IS THE ITEM TO BE ENTERED?";IT$(N + 1)
2742 HOME: VTAB 10
2745 INPUT "WHAT IS THE STATUS; FINISHED OR NOT FINISHED?";ST$(N + 1)
2750 N = N + 1: CH = CH + 1
2755 PRINT "DO YOU WANT TO ADD ANOTHER ITEM?"; GET A$
2757 HOME: VTAB 10
2760 IF A$ = "Y" THEN 2705
2765 PRINT "ARE YOU READY TO WRITE ALL THIS TO DISK?"; GET A$
2767 HOME: VTAB 10
2770 IF A$ = "Y" THEN GOSUB 2810
2775 RETURN
2800 REM WRITE TO DISK
2810 L = 1: D = 1: C = 1: F$ = "MEMOS"
2820 PRINT CHR$(4); "OPEN"; F$
2822 PRINT CHR$(4); "WRITE"; F$
2825 IF E = 1 THEN PRINT NN: GOTO 2840
2830 PRINT N
2840 FOR K = 1 TO N
2845 IF E = 1 AND ST$(K) = "FINISHED" THEN 2880
2850 PRINT DA$(K): PRINT IT$(K): PRINT ST$(K)
2880 NEXT K
2890 PRINT CHR$(4); "CLOSE"; F$: WR = WR + 1: CH = WR
2898 PRINT: PRINT: RETURN
2899 REM SEARCH FOR DATE AND PRINT
2900 CO = 0
2905 W = LEN(SE$)
2906 GOSUB 3000
2910 FOR K = 1 TO N
2920 IF LEFT$(DA$(K),W) = SE$ THEN 2960
2930 NEXT K
2940 HOME: VTAB 12: IF CO = 0 THEN PRINT "NOTHING FOR " SE$: PRINT: PRINT
2945 PRINT " PR#0": PRINT
2950 RETURN
2960 IF CO > 0 THEN 2969
2961 HOME: HTAB 25
2962 PRINT "APPOINTMENTS FOR ** " SE$, 1980 **"
2963 FOR I = 1 TO 80: PRINT "="; NEXT I
2965 PRINT "THE ITEMS ON THE CALENDAR ARE:"
2967 PRINT: PRINT
2969 PRINT MID$(DA$(K),1, LEN(DA$(K)) - 2)
2970 PRINT "ITEM # " RIGHT$(DA$(K),2)
2975 PRINT TAB(20) IT$(K)
2980 IF ST$(K) = "FINISHED" THEN PRINT "COMPLETED"
2982 IF ST$(K) = "NOT FINISHED" THEN PRINT "NOT COMPLETED"
2984 PRINT: PRINT
2985 CO = CO + 1
2990 FOR Z = 1 TO 3000: NEXT Z
2995 PRINT: GOTO 2930
3000 REM PRINTER
3010 HOME: VTAB 12
3020 PRINT "PRINTER ? (Y/N) "; GET P$
3030 HOME
3040 IF P$ = "Y" THEN PRINT " PR#1"
3050 RETURN
22570 PRINT "ITEM # " RIGHT$(DA$(K),2)

```

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bered d. Default values are 10 for a and b, and the beginning and end of the program for c and d.

TRACE [xx[,print list]]. Traces the logic flow of a program. After each statement is executed, its line number is printed in square brackets. The run begins at line xx if the parameter is included. The print list may be anything normally found after a PRINT command, so that variable values may be traced as the program executes. I find it helpful in some cases to include a CHR\$(17) (i.e., HOME) in the print list so that the changing values stay in a fixed position at the top of the screen rather than scrolling.

HELP xx. This command is used to find a non-obvious error in a line. The line is executed in command mode until the error is found, and then the line displayed in EDIT mode with the cursor over or near the error. Note that there are some errors HELP can't detect, and also that any GOTO encountered will be executed. Still, I have found this to work, though I can envisage situations where it could be tricked by changed variable values, etc.

FIND ['] string. Lists all program lines containing the string. If it is anticipated within PRINT or REM statements, the quote should be included. A wildcard character **&** can be used within the string to represent any single character.

DEF x. Defines a function key, where x is any single-digit number. Enter any function (series of commands to be executed) from one to 1000 characters long. Up to ten functions may be defined or redefined. Graphics RAM is used as the buffer, starting at FFFF and going down. To terminate a definition input, CTRL-C is used. To use the defined function x, just use CTRL-x. A special input character i may be used in the definition to pause for keyboard input, similar to the BASIC input statement.

VAR. Lists the values of any scalar numeric or string variables currently defined. This is helpful to find out why an error has occurred. No array variables are listed, and the list is in order of creation as the program is executed.

LIST [xx[,yy]]. Lists the program—the usual graphic shorthand can be used. The listing is from line xx to yy. If the parameters are omitted, they default to program start and end, and if yy is omitted, it defaults to xx (i.e., LIST 100 lists line 100).

DEL [xx[,yy]]. Deletes lines from the program. Parameter defaults are as for LIST.

CLOSE. Eliminates all blanks other than those in REM statements or within quotes. This is used to reduce the amount of memory required to store the program.

OLD. May recover your program after a goof—accidental RESET, DEL or NEW, or a failure in CLOAD. If RESET was hit, System 3 must be restarted first by exiting to the Monitor and typing GO F070.

CTRL-P. Starts or stops output to the printer. It does not work while a program is running, but you can temporarily halt the program with the RUN/STOP key to allow CTRL-P to be used. It works in BASIC or the Monitor. The system is set up to drive the Centronics output, but it can be changed to another driver by inserting its address in locations F074 and F075.

CLOAD?. Verifies a program on tape by reading it to check for CRC errors, similar to the Monitor Files command. This ensures that there is no corruption of memory if a CRC error does occur. This command is handy if you want to be sure that the program you just saved can be reread.

MERGE. Merges a tape program onto the end of the current one. All the line numbers in the second program must be larger than the last line number in the first program. Care must be taken that no duplication or overlap of line numbers occurs. Any failure to observe this will lead to unpredictable results. The program will only be merged if the tape read is successful.

Evaluation

As you can see, quite an impressive array of commands is available with this program. System Software guarantees that it will cut programming and debugging time by half, and offers total satisfaction or your money back. Is their faith in their product justified? I think it is.

Some of the facilities offered are worth the price on their own, even without all the extra commands. Two CTRL-Ps and a LIST will get me a listing of a program. Furthermore, since unwanted control codes are filtered from the input buffer, you can input ?CHR\$(12); :LIST <CTRL-P><CR> and the printer does not output the command line, since it was echoed before the printer was enabled. The purpose of the CHR\$(12) or form-feed is to feed my printer to the start of the next page.

Of course, there are always more facilities you would like in any program. System Software offers a customizing service, so if you have a real need for further or modified commands, they're at your service.

System Software, 1 Kent St., Bilton, 6157, Western Australia, Australia (09-339-3842).

Dr. Ivan D. Reid
North Adelaide
South Australia

Touch Typist

Newline Software
Littleton, MA
System: Heath

I used to type about the same way I

chopped firewood: with a great deal of gusto, but not much finesse.

I do a lot of writing in my job, mostly at the keyboard of my company's H-89. Thanks to our Heath AutoScribe word processor software, typing mistakes were readily corrected. Since I could muster better than 40 words per minute with my eyes (scanning the keyboard as I typed), I felt no compelling need to learn to touch type.

But I invariably had trouble transcribing material. In such cases I had the secretary do the work, rationalizing that I had something more pressing to do right then.

I think that my colleagues saw through that ruse, however, because one day a disk was anonymously left in my office with a note attached which told me to use the disk immediately. I discovered to my initial chagrin that it was a computer-aided instruction course called Touch Typist, from Newline Software. I say chagrin because I still (after all these years) have vivid memories of my high school typing class, and the horrors of learning to touch type.

My curiosity got the better of me, though, and I tried the software. While nothing can completely ameliorate the drudgery of learning to touch type, Newline Software has come up with a program to make it interesting and a challenge. The program not only helps the student learn to touch type, but also to finely hone the skills necessary to be able to type accurately and quickly. Interspersed throughout the lessons are tips on typing techniques, such as leaving two spaces after a period before the first character of the next sentence. While tips of this nature may be common knowledge to the experienced typist, they are new information for the new student. And for those who already know how to type, there are practice lessons to help improve speed and accuracy.

Each lesson begins with text which describes what new techniques will be learned in that lesson. The student is then given drill patterns to practice, followed by a review at the end of the lesson. The software uses good teaching practice by telling the student what will be taught, teaching that material, then reviewing (with speed drills usually) the material.

Touch Typist will run on any Heath H-89, H8/H19/H17 or Zenith Z89 system with 24K memory and HDOS version 1.6 or higher. The typing tutor package consists of three series of lessons:

- The T series of lessons, in which the student learns to touch type on the standard keyboard. The student is introduced to each letter on the keyboard, one letter at a time. After completion of this series of lessons, the student is able to touch type the entire alphabet and some of the standard symbols by touch.

- The N series of lessons teaches touch

typing on the numeric keypad (the numeric keys on the right side of the keyboard). This feature is particularly useful for data entry applications (and using a push-button telephone).

•The S series reinforces the T series with speed and accuracy drills. This series of lessons consists primarily of paragraphs for the student to type. There are also valuable hints and rules of style.

Each lesson contains practice drills to improve speed and accuracy. Touch Typist displays a line of text in the middle of the screen, and instructions, if appropriate, at the top of the screen. The student then types the line as shown. The program checks each character as it is entered. If the character is correct, nothing happens. If the character is incorrect, then a large X is displayed under the erroneous character and the terminal bell beeps (you soon learn to hate that bell).

If an error is made, nothing can be done about it during that drill because the backspace key is not operative (indeed, the backspace key isn't even taught until about halfway through the T lessons). The student finishes that drill, after which the same drill is presented again. The program checks each drill for the number of errors made. If the number of errors on any given drill is not excessive (it seems to vary from drill to drill), then

My typing speed went from 40 wpm with my eyes keeping my fingers honest to 40 wpm without looking.

the next drill is presented. If the number of errors is excessive, the same drill is continuously presented to the student. If, after a few futile attempts, the student has not mastered the drill, the program offers a graceful way out of the drill: simply hit the escape key to move on to the next lesson.

The program is not totally forgiving, however. If the student takes the easy way out of a particularly difficult drill, the tally at the end of the lesson tells the student that the lesson was completed but a number of lessons were skipped (it tells how many).

Most lessons end with a speed test. This is where a personal computer really comes into its own for tutorial lessons. The challenge is there to better one's previous typing speed and accuracy, and the speed drill is there whenever the student wants to try it, whether it is immediately after completing a previous lesson or

three o'clock in the morning.

Touch Typist will display a paragraph on the screen. The student should then type the entire paragraph as quickly and as accurately as possible. As each character is entered, it is checked for accuracy. If it is correct, again nothing happens. If it is incorrect, Touch Typist will beep the terminal bell again and write the errant character in reverse video (a black character on a white background). Now, however, the backspace key is operational. The student may correct any typing errors by using the backspace key, but the character will still be counted as an error. To add further challenge, a timer is started as soon as the first key is struck and does not stop until the paragraph is completed.

For those with a low frustration threshold, it is possible to "fool" the computer into thinking that the paragraph has been finished by holding down any key, along with the repeat key, until the end of the paragraph is reached. At that time simply hit the carriage return and watch your blistering speed of 224 wpm (words per minute) flash on the screen. Of course, the number of errors is also displayed, which in that case will be considerable.

The important thing to note is that at the end of each speed drill, the number of errors and the typing speed in words per

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minute (wpm) is displayed, thereby giving the student immediate feedback.

The nonbootable, write-protected disk comes with two sheets of instructions, for either single-drive or multidrive systems. An owner with absolutely no experience with using system programs such as Onecopy should have no trouble whatsoever following the instructions. I wish that all software houses would pay as much attention to documentation as Newline Software has.

But does it work? Absolutely. The user's success will certainly depend upon how well the lessons are followed, and how well the user applies him- or herself. No computer-aided instruction program can assure that the student will have perfect mastery of the material at the end of the lessons. But the student's success is in part a measure of the program. In my case, my typing speed went from 40 wpm with my eyes keeping my fingers honest to 40 wpm without looking. I now have not only the ability to transcribe material without resorting to my old typing method, but I also have the skills necessary to improve my typing speed and accuracy. After all, the name of the game is accuracy.

Newline Software, PO Box 402, Littleton, MA 01460.

**J.C. Hassall
Blacksburg, VA**

CRAE

Highlands Computer Services
Renton, WA
System: Apple II
\$15

Writers of BASIC programs have many tedious housekeeping chores. They have to number the lines of their programs. They have to keep these line numbers consistent during such procedures as GOTO and GOSUB, particularly as the programs are being revised. They have to keep the spelling of variable names consistent; and if they need to change the spelling of a variable name, they must change every occurrence of that variable.

BASIC program writers also sometimes have to patch one program into another; or repeat virtually the same sequence of commands in different parts of the same program; or, in debugging, locate every occurrence of a given string.

These are boring tasks. Programmers like to have utility programs which do these chores. One such program, designed for the 48K Apple II, is CRAE (Co-Resident-Apple-Editor) sold by Highlands Computer Services, Renton, WA.

At \$15, CRAE is a good buy, a useful tool for those users who are more than casual programmers. It will join two BASIC programs together; it will find and change strings within a program; it will

list a program or provide a hexadecimal dump of a range of memory; it will "quote" one section of a program in another section; it will automatically number and renumber program lines. And it does all this with just nine short commands.

The Program

You first boot the system with the CRAE disk, or use the PR#6 command. CRAE is then automatically loaded in the 12K of memory below 48K, and you are asked, "Do you want instructions?" If you say, "No," the machine returns to Applesoft II BASIC, and CRAE becomes "invisible."

When you need CRAE, you must first type an ampersand (&) as the first character in a line on the CRT. CRAE will then drop down to the next line and display a left bracket (ASCII character 219 decimal, DB hex). This contrasts with the Applesoft right bracket prompt (ASCII 221 decimal, DD hex).

One serious flaw at this point: apparently the only practical way for users to return to Applesoft (and, for example, run their programs) is to hit the reset key. This isn't fatal though; you're returned to BASIC rather than to the machine monitor, and both CRAE and the user program are intact. Still, it does seem reasonable to ask that CRAE have a graceful exit procedure, and/or a facility for running BASIC programs within CRAE's umbrella.

The commands are simple. Each begins with a single letter; then, depending on the command, you can have from zero to four parameters which specify the string to be located or changed, or the range of lines to act upon. Each parameter (except, in some cases, the first) is separated from the others by either a slash or a comma. The commands would be even simpler, of course, if the delimiter were consistently either a slash or a comma, and if the delimiter were consistently required (or not required) for the first parameter as well as the others; but these inconsistencies are a nuisance, not a serious flaw.

The Append command joins two BASIC programs together. The first program is brought into memory; the Append command is issued, and you're prompted for the name of the second program, which should be on disk. Be sure the line numbers of the second program are larger than those of the first.

The Change and Verify commands both alter a given string. Both can be limited to a specific line range. The difference is that Verify, in spite of its name, does not verify—i.e., echo—the change. The Find command will locate a given string, but will not change it. Like the Change and Verify commands, it can be set to operate within a specified line range.

The Quote command repeats a given range of lines in a different section of the program without deleting the original set

of lines. The same sequence of commands can therefore be used in two different parts of the program; and there are some situations where this procedure is preferable to the use of the GOSUB command—where, for example, the programmer wants to avoid jumping out of or into a FOR...NEXT loop.

The Auto Line Number command (which uses the letter N) automatically provides line numbers for a program. You can specify the starting line number and the increment. The Dump command gives a hexadecimal dump for a specified range of memory, a function duplicated in the Applesoft ROM.

The Renumber command is also duplicated in Applesoft; in fact, the Applesoft version is somewhat better because it can handle longer programs. And finally, the List command essentially duplicates the Applesoft List command, but does not produce as readable a listing because it eliminates "extraneous" spaces.

As far as I can tell, the error-trapping routines are flawless—although the error messages are sometimes cryptic ("err<0," for example). Still, experienced programmers should have few problems deciphering the error messages; often they simply mean that the user has entered a BASIC command or line number instead of a CRAE command.

The Most Serious Problem

The most serious problem with CRAE, as with so many programs, is the user documentation. The user's manual has 17 double-spaced pages, including the cover, and not all of these are full pages. Most of the commands are explained in less than one page. This one page will explain the purpose of the command and present the format for the command. In many cases it will also present a few examples of the command format. But there are very few examples of the results (i.e., printouts showing what happens when you use the commands.)

Also, no tutorial is included to lead users step-by-step through the program. Tutorials are probably the most effective device available for showing users how a program works, and I believe that every user's manual should contain one. In CRAE's case, it would have been easy to include a tutorial on the disk.

If we assume that CRAE is intended only for experienced programmers, we can to some extent excuse its poor documentation (although I have to wonder why people who hope to make money from their programs would exclude less experienced programmers from their market). CRAE is simple enough that experienced programmers can figure out for themselves just how the commands operate. Still, while I get satisfaction from solving the puzzle of what the commands do, it is only grim satisfaction, tempered by resentment that the authors have presented me with this unnecessary puzzle.

But in spite of its poor documentation

and its lack of a graceful exit routine. I am satisfied with CRAE. It probably does no more than many other programmer aides (such as Applesoft's DOS Toolkit), and perhaps it does not do them as well. But I am content. I was weary of eyeball editing, and I'm delighted with the help that CRAE gives me. Especially when I look at that \$15 price tag. You'll have a hard time beating that.

Highland Computer Services, Renton, WA.

Brownlee Elliott
Bloomfield Hills, MI

Flash Attack

Mach 2 Software
Danbury, CT
System: PET
\$15

Flash Attack is a multimachine game that provides infinitely more challenge than do the you-against-the-computer games.

The 40 x 60 playing field shows a terrain of mountains, consisting of cross hatched squares, or forest, represented by groups of trees. Both players have a command post, five tanks (to be used one at a time), walls to build dummy command posts, land mines, missiles and tank and command post guns. The object is to destroy your opponent's com-

mand post (actually a wall of the command post).

The game is challenging because you can't see the entire playing field, only a small window around your command post and the current position of your tank. The numeric keypad moves your tank, using one unit of fuel for each square moved. In the heat of battle, it's easy to forget this and end up stuck far away from your base.

Tanks may not move over the mountains, nor can shells destroy mountains. Tanks may pass through forests, and any kind of a shell will destroy them. Mines laid by your tank are visible to you, but not your opponent. A square containing a tree cannot contain a mine.

CB2 sound effects indicate firing a gun, hitting a mine and launching an ICBM.

If your tank is hit by a shell from another tank, it will go from condition green to amber, or from amber to red, or from red to destroyed. Running over a mine is equivalent to being hit by two tank shells. If a tank is hit by either a command post gun or an ICBM, it will be destroyed no matter what its condition was. A tank in condition red will move only about half the time a direction key is pressed. Returning to the command post will completely repair and reequip the tank.

As good as this program is, it has a few drawbacks. The most obvious is that it is much easier to come up with two people to play the game than two PETs to play it on. Also, the program is uncopiable; I worry a little about what happens when my tape wears out. Hopefully, it will soon be available on disk.

Occasionally random patterns of mountains box in a command post, making that game unplayable. Both tanks are represented as diamonds. It would be easier if they could be distinguished from one another. Occasional keystrokes cause the program to jump back to BASIC for no apparent reason.

My user group has spent the better part of its last three meetings playing Flash Attack, making it the most popular game we've ever tried. The authors have indicated they are working on other games of this type. We hope so, because we'd like to encourage them to continue to produce what would be best described as a new class of games.

Mach 2 Software, 96 Hammersmith Apts., Danbury, CT 06810.

Daniel M. Kapsch
Miamisburg, OH

MOVING?

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Exidy's Sorcerer is a fine machine, with one of the quickest BASICs around. However, this speed is achieved at the expense of some complexity and numerical accuracy. For most applications, the accuracy is unimportant, but there are times when you wish that the ROMPAC supported a few more features (see, for example, "A Sure Cure for Those 'SN ERROR' Blues" by Randy L. Henne, May 1981, p. 142). Now there is a simple and relatively inexpensive method to add editing, renumbering, and several other facilities to your Sorcerer.

Richard Swannell, a young Perth programmer, has set up a small software house in Western Australia dealing exclusively in Sorcerer software. One of his offerings is a programmer's aid which can cure most of the blues a Sorcerer programmer may have. For your \$29.95 (plus \$2.00 for airmail—recommended because of the slow surface mail to and from Australia) Richard will send you a cassette containing the program, and a small printed sheet explaining the facilities that are offered.

The tape is recorded with three copies of the program, two on the first side at 1200 baud and one on the reverse at 300 baud. The tape is protected against unauthorized copying, but Richard offered to let me know how to defeat that if it turned out to be a problem. I believe future copies will not be protected. I have had no problems loading the tape at the higher speed, though I always record my own programs at 300 baud for extra security.

The program must be loaded before you start entering your BASIC program, as it first loads into low memory normally occupied by BASIC source code. It is recommended that the LOG command be used. But I've successfully operated it by using the GO command after a normal load. When loading, the Monitor message is indicating a program 1050 bytes long starting at 0F00 and an auto-execution address of 0F00 as well. Once loaded and execution has commenced, the program relocates itself into the top of RAM and resets the BASIC top-of-RAM indicator to prevent it from being overwritten. In this way, the program can be used with any memory size, operating just as well on my 48K machine as it would on an 8K Sorcerer.

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The commands are shown in Table 1.

The two modes, replace (R) and expand (X), are indicated by a single character at the top of the screen. In R mode, typing a character will replace the character under the cursor with the one typed, and move the cursor to the next position. In X mode the cursor and the rest of the line shift along and the typed character is inserted before the cursor. In R mode, typing up to the end-of-line delimiter will expand the delimiter across the screen and onto the next line if necessary.

If the down-arrow command is given when the current line is the last line in the program, a new line number is displayed with value yy greater than the last.

AUTO [xx[,yy]]. Enters AUTO mode. The next line number is displayed on the screen ready for a new line. If the line number is duplicated in the program, a full colon is displayed under the cursor. If a new line is not to be entered, LINEFEED skips to the next line.

All edit commands are available, but once you have gone into EDIT mode (e.g., used cursor-up to edit a mistake in a previous line) then RETURN will put you back to command mode. Parameter xx is the initial line number, and yy is the increment.

REN [a[,b[,c[,d]]]]. Renumber BASIC program with first new line number a, increment b, first line of original program to be renumbered c, and last to be renum-

Keypad right-arrow	Move cursor right
Keypad left-arrow	Move cursor left
Keypad X	Scan cursor
Keypad '=' or CLEAR	Delete character under cursor
Keypad '.'	Truncate line
Keypad divide	Toggle mode (X or R)
RUB	Backspace (RUB in command mode).
TAB	Now tabs
REPEAT	Repeats last key
CTRL-C	Quit without editing
RETURN	Enter edited line
Keypad down-arrow	Enter current line and edit next
Keypad up-arrow	Enter current line and edit previous

Table 1.

(continued on page 203)

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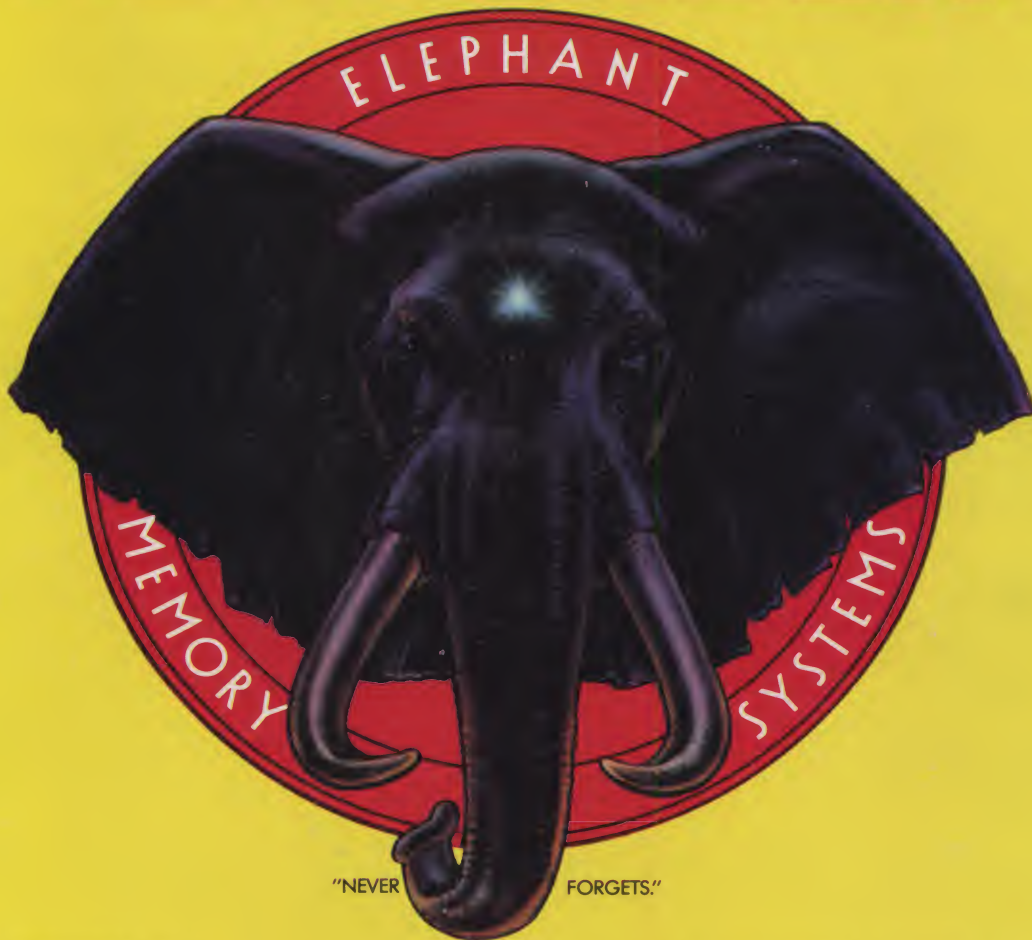
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